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DEPARTMENT OF THE ARMY

NBC
DEFENSE
REFERENCE
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STUDY GUIDE

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INTRODUCTION TO UNIT NBC DEFENSE

Unit NBC defense measures are those actions taken by personnel in a unit to survive in an NBC environment. Implementation of these measures will require constant coordination and supervision. In units which do not have a Chemical Corps officer or NCO assigned, the commander must appoint an NBC defense officer and NCO on an additional duty basis.

The overall responsibility for the success of the unit NBC defense program rests with the unit commander. As an NBC officer or NCO, however, you will be the commander's representative in these matters. Whether assigned to a company or a battalion, it will be your job to establish and maintain the NBC defense program for that unit. It will also be your responsibility to keep the commander abreast of the NBC posture of the unit. You may find that it will require a certain amount of salesmanship to gain the command emphasis needed to promote your NBC defense program. If you can show how your program will blend with and, in fact, enhance the accomplishment of the unit's primary mission, you will probably have little difficulty initiating your program.

Paramount to the NBC training program initiated by the NBC officer and NCO is the integration of NBC tasks into everyday training. Perhaps the most frequent failing of most NBC training programs is its failure to become just another aspect of routine mission accomplishment. The focus should be on a soldier's ability to clean his or her weapon as easily in MOPP posture as without MOPP. The true secret to success will be not only convincing the commander, but to convince the many first line supervisors that NBC task integration is not difficult, not time consuming when proficient, and essential on the integrated battlefield.

The focus of this unit and the other units found in this series is to prepare the additional duty NBC officer and NCO to return to his or her unit with the knowledge to conduct small unit operations on the integrated battlefield. More specifically, our purpose is to train first line supervisors to accomplish their major ARTEP tasks when placed in an NBC environment and to maintain assigned equipment in an operational ready status.

INTRODUCTION TO OPERATIONS IN AN NBC ENVIRONMENT

During World War I, chemical agents were introduced to the battlefield with devastating effects. One reason for the enormous number of casualties was that soldiers were unaccustomed to operating in a chemical environment. Since the introduction of chemical agents, improvements have been made in the protective equipment available to protect personnel.

In 1945, nuclear weapons were first employed in war. The effects of these weapons proved to be more destructive than any single weapon used by man up to that point. In addition to the destruction, these weapons held a new feature that continued to cause casualties long after the initial burst. Nuclear radiation can continue to cause casualties through radiation for long periods of time and many miles away from the point of detonation.

Even as late as World War II, there were more American soldiers removed from battle by sickness and disease than by combat wounds. Imagine the impact if biological agent had been intentionally employed as a weapon.

Only through proper use of protective equipment and application of prescribed NBC defense measures can a unit operate within an NBC environment.

SUPERVISE FITTING PROTECTIVE MASKS

CONDITIONS:

Given: Two or more soldiers with serviceable protective masks that require fitting.

STANDARDS

1. Masks are adjusted for proper fit: M17-series masks in accordance with TM 3-4240-279-10; M24 and M25-series masks in accordance with TM 3-4240-280-10.
2. Masks are checked for a proper fit: M17-series masks in accordance with TM 3-4240-279-10; M24 and M25-series masks in accordance with TM 3-4240-280-10.
3. Masks are checked for leaks: M17-series masks in accordance with TM 3-4240-279-10; M24 and M25-series masks in accordance with TM 3-4240-280-10.

CAUTION

A mask that leaks will not protect soldiers from toxic chemical agents. The mask must be checked for leaks each time it is put on.

Soldiers must be clean shaven as beard growth may cause a bad seal between face and mask.

Female soldiers must remove all hairpins, combs, hair knots, buns, or braids which will interfere with mask seal.

PERFORMANCE MEASURES

1. Directs the fitting of protective masks.
 - a. For M17-series protective masks refer to TM 3-4240-279-10.
 - b. For M24 and M25-series protective masks refer to TM 3-4240-280-10.
2. Check the protective masks for proper fit.
 - a. For M17-series protective masks refer to TM 3-4240-279-10.
 - b. For M24 and M25-series protective masks refer to TM 3-4240-280-10.

3. Checks the protective masks for leaks.

a. For M17-series protective masks refer to TM 3-4240-279-10.

b. For M24 and M25-series protective masks refer to TM 3-4240-280-10.

REFERENCES

FM 21-3, Task 031-503-3012

SUPERVISE FITTING OF PROTECTIVE MASKS

The mask must be checked for fit. Check the following items to ensure the mask is adjusted for proper fit to the soldier's face.

Temple straps are above the ears.

Buckles are flat and the straps form a straight line with the tabs.

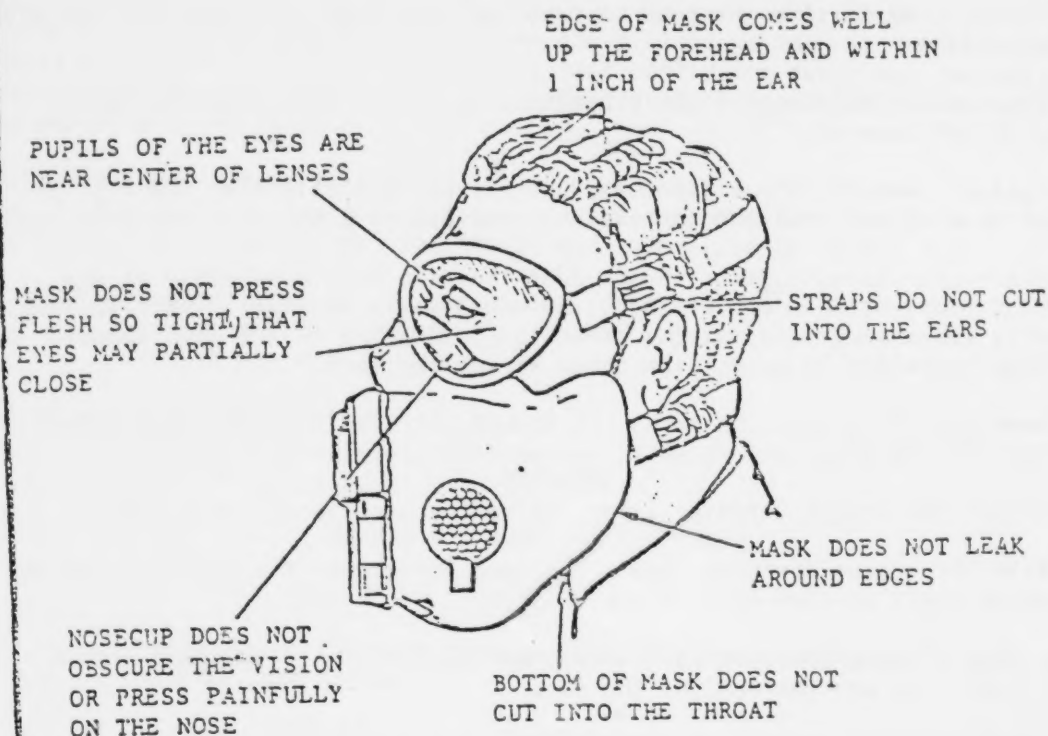
Pupils of the eyes are near the center of the lenses.

Edge of the mask fits well up on the forehead and within 1 inch of the ear.

Next, have the soldier press the palms firmly over the inlet valves. Do not press so hard that the facepiece is distorted. This could cause leaks.

Now have the soldier inhale lightly and hold breath for 10 seconds. If the facepiece tends to collapse and remain collapsed during this time, the mask is effectively airtight.

CHECK MASK FOR FIT.



The initial fitting of the protective mask cannot be overemphasized. It is necessary to ensure that any small unit is combat ready. Imagine the number of casualties that would result if every member in a platoon was not properly fitted with their assigned protective mask, and that fit was never tested for leaks.

INITIAL FITTING

The initial mask fitting should be performed by the unit NBC NCO or another trained person. Soldiers to be fitted will need masks and seating facilities. Extra masks in assorted sizes should be readily available. The fitter will follow the procedures below the fitting each mask for the first time.

Ask the soldier to seated.

Hood and eyelens outserts should be removed. Straps on the head harness should be loosened so the metal tips at the strap ends are about 1 inch (2.5 centimeters) from the clip-buckle assemblies.

Have wearer open the facepiece assembly with thumbs under the head harness.

Instruct wearer to place chin into the chin pocket.

Tell wearer to slip the head harness over the head while pulling the mask over the face.

Have wearer hold mask tightly against the chin. Make sure the outlet valve is not covered.

Instruct wearer to position head harness pad directly over the high point on the back of the head and to hold the head pad in place with the free hand.

Place your forefinger or thumb under the clip-buckle assembly of one forehead (top) strap and give the strap end a sharp tug until the clip-buckle assembly feels snug. Adjust the other forehead strap in the same manner. Use the same technique to adjust the cheek straps (bottom).

Have wearer release the mask. It should not slip. If the mask slips, readjust the forehead and cheek straps until it remains in place.

Adjust the temple (middle) strap, using the same technique as above.

With the wearer standing, check the mask for proper fit according to the following eight points:

- Edge of mask comes up on forehead but not into hairline, and within 1 inch (2.5 centimeters) of the ears.
- Temple straps and cheek straps do not cut into ears.
- Eye pupils are centered in the eyelenses.
- Mask does not press skin so tightly that eyes are partly closed.
- Mask does not leak around the edges.
- Bottom of mask does not cut into throat.
- Skin in front of ears is not wrinkled.
- Nosecup assembly does not obscure vision or press into the nose.

Optical Inserts (if used)--Fit prongs of plastic frames into alternate holes in the optical insert supports. Install wire frames inside eyelenses of mask facepiece.

NOTE: Optical inserts are personal issue items. Inserts should be retained throughout a soldier's military career.

If mask is difficult to fit, try another size. When you have an apparent fit, the mask should be checked for leaks as described below.

Testing for Leaks

Testing the fit of the mask can be accomplished in two ways: chamber exercise and banana oil method. The chamber exercise is an effective method when checking the fit of the mask of a large number of soldiers. The chamber exercise also provides a vehicle for soldiers to gain confidence in the protective mask and should be used when the protective mask is due its semi-annual services. Prior to conducting a mask confidence exercise, you must check local policies and regulations. The procedures to conduct the exercise are outlined in FM 21-48.

Another method to test fitting of the mask uses banana oil (isoamyl acetate) and is less costly. The liquid comes in ampules and bottles--ampules are preferred. It is effective, available, and authorized in TB Med 223.

NOTE: Isoamyl acetate, or banana oil, does not replace the use of the CS chamber. The chamber instills confidence in the protective mask.

Health and Safety Precautions

WARNING

Banana oil vapor is flammable..

Banana oil liquid may irritate skin.

Banana oil liquid and vapor may irritate the eyes , nose, and throat.

CAUTION

Liquid banana oil penetrates and softens hood and mask facepiece materials.

Before getting into how you use the banana oil, there are some health and safety precautions you must be aware of. Observe the following precautions in all uses:

Conduct banana oil vapor test outdoors or in a well-ventilated indoor location.

Banana oil vapor is flammable. No open flame or smoking can be allowed in the test area.

No special storage conditions are required for ampules; but be careful not to crush boxes containing them.

Persons conducting tests must wear rubber gloves if the vapor source wets their fingers. After testing, the tester must wash gloves and hands with soap and water. If tester experiences eye, nose, or throat discomfort, he or she must wear a protective mask.

Dispose of used ampules in an outdoor trash container.

Conduct the Test

The Chemical Research and Development Center recommends vapor testing masks when initially issued and periodically thereafter. Banana oil vapor tests are made after the mask has been properly fitted and checked for leaks.

It is easier to do the test when the masked soldier is seated. Instruct the wearer to breathe normally. Crush the ampule according to manufacturer's instructions. Move the crushed ampule around the edge of the mask facepiece where it forms a seal with the face. Keep the ampule 1 to 2 inches from the edge of the mask. Do NOT touch the mask or the soldier with the ampule. Liquid banana oil penetrates and softens hood and mask facepiece materials. Exposure to liquid or prolonged exposure to vapor can cause severe skin irritation.

Use the same testing technique for the components in the front of the facepiece, such as the eyelenses, air intakes, and voicemitter assembly.

If the wearer smells banana oil vapor and if strap adjustments do not eliminate the odor, he or she has the wrong size mask or has a faulty mask. It should be turned in for replacement or repair.

One ampule should test 5 to 10 masks during initial fitting; 10 masks during rechecks.

Conditions for Masking Without Order or Alarm

Once an attack with a chemical or biological agent is detected or suspected, or information is available that such an agent is about to be used, you must STOP breathing and mask immediately. Under the following circumstances, do not wait to receive an order or alarm when:

- Your position is hit by:

Artillery or mortar fire.

Missiles or rockets.

Smoke or mists.

Aerial spray or bombs.

- Smoke from an unknown source is present.

- A suspicious liquid or solid is present.

- You are entering an area suspected of being contaminated.

- You have one or more of the following symptoms:

An unexplained runny nose.

A feeling of choking or tightness in the chest or throat.

Dimming of vision.

Irritation of the eyes.

Difficulty in or increased rates of breathing without obvious reasons.

TECH ASPECTS OF CB DEFENSE

IDENTIFY ELEMENTS OF AN NBC ATTACK

Threat nations are capable of employing NBC weapons in large numbers. They have delivery systems with great range and mobility. These attacks will not appear the same as conventional attacks, although NBC attacks will certainly be exploited using conventional means. Instead NBC attacks may appear as an enormous cloud, a fine mist, or liquid droplets. Yet, they can be deadly to a soldier who does not recognize the hazard and is not prepared to defend against it. Therefore a fundamental aspect to protection is understanding the hazards as they will be employed. As an individual and then as a first line supervisor you must check to ensure that you and your subordinates are able to recognize an NBC attack.

Identifying the elements of an NBC attack require you to be able to:

Recognize a chemical attack.

Recognize a biological attack.

SUPERVISE PROTECTION OF PERSONNEL

Supervising the protection of personnel in your unit really boils down to supervising the immediate defensive measures outlined in the Soldier's Manual of Common Tasks. These include, recognition of an attack, and those actions necessary to survive. These steps include but are not limited to assuming and maintaining the proper MOPP level and performing individual decontamination as required.

Characteristics of Chemical Agents

Planning for the defense against chemical agents employed by Threat forces will be incorporated into the scheme of offensive and defensive maneuvers by all US Army units. Chemical strikes may be employed in an antipersonnel role to destroy US defenses or may be used to contaminate specific areas with persistent agents to act as an obstacle. It is certain, however, chemical agents will be used by Threat forces to attempt to destroy our offensive capabilities.

Chemical agents are affected by the environment. Weather conditions have a significant effect on the behavior of chemical agents. There are certain times and conditions where they can be employed most effectively. The most favorable conditions usually occur at night, during early morning, at dusk, and when there is a heavy overcast with light, steady winds. Smooth terrain is usually more favorable for the employment of chemical agents than rough terrain. Low places generally are more favorable than higher elevations. Agents tend to linger and settle in the low places and in heavily vegetated areas such as dense woods and urban terrain.

The persistency (duration of effectiveness) of a chemical agent depends on its physical properties, weather conditions, method of agent dissemination, and terrain on which the agent is deposited. The terms "persistent agent" and "nonpersistent agent" express the relative duration of effectiveness of chemical agents in the attack area. These terms do not refer to the duration of the effects of the agents on personnel.

Persistent Agent. The initial sign of a persistent agent attack is liquid droplets of agent. These will resemble rain and may be the consistency of syrup. The droplets may come from: airburst artillery, bomblets, bulk agent filled missile warheads, aircraft spray, or landmines. These agents are used to contaminate equipment and terrain and to cause casualties by skin absorption. The agents may include persistent nerve agents, blister agents, or any combination thereof.

Nonpersistent Agents. The signs of a nonpersistent agent attack are insidious in that they consist of vapors and aerosols from point or above-surface detonating artillery munitions, bombs, or bomblets. Use of these agents is primarily intended to cause casualties by entry into the body through the respiratory tract. The agents may include nonpersistent nerve agents, blister agents, blood agents, choking agents, or various combinations.

Recognize a Chemical Attack

Chemical agents are powerful and are released in ways that enable them to cover large areas. Since the agents are likely not to have smell and little or no color, it is necessary to learn other ways of recognizing chemical hazards. To recognize when a chemical agent is present, you must be able to identify the characteristics of different chemical agents, factors that affect the persistency of agents, and the types of munitions systems used to deliver the agents on the battlefield.

Being alert for the agent symptoms or the delivery weapon is important for protecting yourself and your unit against chemical attack. There are also additional sources of information for determining that an attack is occurring or has occurred. These include alarm systems, chemical agent detector kits, contamination markers, NBC reports, appearance of dead animals, or the appearance of oily substances on foliage.

Characteristics of Chemical Agents

Four types of chemical agents are generally used in chemical warfare: nerve, blister, blood, and choking agents. They may be disseminated in the form of liquids, vapors, or aerosols. They may be persistent or nonpersistent.

Choking Agents. Choking agents usually are disseminated as gases and are taken into the body by inhalation. They affect the respiratory system by damaging the lungs and in extreme cases, causing them to fill with liquid. Choking agents are colorless and have an odor resembling new-mown hay, grass, or green corn.

Symptoms of Choking Agents. Symptoms of choking agents may include:

- Coughing
- Choking
- Tightness in the chest
- Nausea
- Vomiting
- Headache
- Tears

Choking Agents (Lung Damaging Agents)

Chemical agents that attack lung tissue, primarily causing pulmonary edema (fluid buildup), are classified as lung damaging agents. This group includes phosgene (CG), diphosgene (DP), chlorine (CL), and chloropicrin (PS). Of these four agents, phosgene is the most dangerous and is more likely to be employed by the enemy in future conflict. Phosgene is a colorless gas.

Protective Measures. Your protective mask gives adequate protection against choking agents.

Symptoms. During and immediately after exposure to choking agents (depending on agent concentration and length of exposure), you may experience some/all of the following symptoms:

- Lacrimation (tears).
- Dry throat.
- Coughing
- Tightness of chest.

- Nausea and vomiting.
- Headaches.

Self-aid.

- If phosgene is detected, irritation of the eyes, or change in the taste of a cigarette (may become tasteless or offensive) occurs, STOP BREATHING and mask immediately.

- If vomiting occurs, follow procedure outlined in for controlling vomiting when exposed to toxins.

- If it appears that only minimum amounts of the agent were inhaled (you do not experience difficulty in breathing, or if there is an absence of nausea and vomiting, and no more than the usual shortness of breath upon exertion), you may continue normal duties.

- Seek medical assistance if any of the above symptoms occur.

Death. With ordinary field exposure to choking agents, it is not anticipated that deaths will occur. However, prolonged exposure to high concentrations of the vapor and neglect or delay in masking can be fatal.

BLISTER AGENTS. Blister agents affect the eyes and lungs, and blister the skin. Some types are painless, others sting, and still others cause the formation of wheals, or welts, on the skin. Blister agents may appear as colorless to dark brown, oily liquid droplets, but are normally invisible when in vapor form. In liquid or vapor form, these agents may burn or blister any part of the body that they contact, either internal or external. They are effective even in small quantities and produce delayed casualties. A drop of mustard-type blister agent the size of a pinhead can produce a blister 1 inch in diameter. Unprotected troops exposed to a low vapor concentration of agent for a long period of time may eventually become casualties.

Blister agents act on the eyes, the lungs, and the skin; they burn and blister the skin or any other part of the body they touch. They damage the respiratory tract when inhaled, and cause vomiting and diarrhea when absorbed.

Blister Agents

Blister agents (vesicants) include mustard (HD), nitrogen mustards (HN), nitrogen mustards (HN), lewisite (L), and other arsenicals, mixtures of mustards and arsenicals, and phosgene oxime (CX). Vesicants act on the eyes, the lungs, and the skin. They burn and blister the skin or any other body parts that they come in contact with. Even, relatively low doses may cause serious injury. Blister agents damage the respiratory tract (nose, sinuses, and windpipe) when inhaled and cause vomiting and diarrhea when absorbed. Most vesicants are deceitful and there is little or no pain at the time of exposure, except for lewisite and phosgene oxime which cause immediate pain on contact. Thus, in some cases, signs of injury may not appear for several

hours after exposure. Vesicants can be delivered by artillery shell, mortar shell, rocket, aircraft spray, or bombs.

These agents often have a more serious effect than is immediately apparent. While a few blister agents cause immediate pain or irritation, most do not cause any immediate pain, and signs of injury may not appear for several hours.

Symptoms of Blister Agents. Blister agent symptoms may include any of the following:

- Irritation or stinging of eyes
- Irritation of nose
- Stinging of skin, welts, and blisters

Symptoms of Blister Agent Poisoning.

- Instant eye pain upon contact with lewisite and phosgene oxime. No initial pain upon contact with mustard.

- Inflammation and blister (burns), i.e., tissue destruction. The severity of a chemical burn is directly related to the concentration of the agent and the duration of contact with the skin. The longer the agent is in contact with the tissue, the more serious the injury.

- Vomiting and diarrhea. Exposure to high concentrations of vesicants may cause vomiting and/or diarrhea.

- Death. With ordinary field exposure to vesicant vapors, it is not anticipated that death will occur from the internal body (systemic) effects of the absorbed agent. However, such deaths may occur from prolonged exposure to high concentrations of vapor or instances of extensive liquid contamination (over wide areas) of the skin, particularly when decontamination is neglected or unduly delayed.

First Aid Measures

Step 1. Use your M258A1 decontamination kit to decontaminate your skin and use water to flush contaminated eyes. Decontamination of vesicants must be accomplished immediately.

Step 2. If blisters form, cover them loosely with a field dressing and secure the dressing.

CAUTION

Blisters are actually burns. DO NOT attempt to decontaminate skin where blisters have formed.

Step 3. If you receive blisters over a wide area of the body, you are considered seriously burned. Seek medical treatment IMMEDIATELY.

Step 4. If vomiting or diarrhea occurs after having been exposed to blister agents, seek medical treatment IMMEDIATELY.

Protective Measures. Your protective mask with hood and protective overgarments provides you protection against blister agents. If it is known or suspected that blister agents are being used, STOP BREATHING, mask and put on all of your protective overgarments.

CAUTION

Large drops of liquid vesicants on protective overgarment ensemble may penetrate garment if allowed to stand for an extended period. Remove large droplets as soon as possible by pinch blotting with M258A1 towelettes or other disposable material.

BLOOD AGENTS. Blood agents usually are disseminated as vapors or gases and are taken into the body by breathing. They affect the circulatory and respiratory systems by preventing the body cells from using the oxygen carried by the blood. After inhaling a high concentration of blood agent; a human may become unconscious and die within a few minutes. Blood agents are colorless, but may have a faint odor similar to peach kernels or bitter almonds. Some blood agents are very irritating to the eyes and mucous membranes.

Symptoms of Blood Agents. Depending upon the amount of agent present, the effects of blood agents may range from mild incapacitation to death. Some of the symptoms are:

- Vertigo (dizziness)
- Nausea
- Headache
- Convulsions
- Coma

NERVE AGENTS

Background Information

Nerve agents are among the deadliest chemical agents. They can be delivered by artillery shell, mortar shell, rocket, aircraft bomb or spray, and land mine. Nerve agents enter the body by inhalation, ingestion, and through the skin. Depending on the route of entry and amount, nerve agents can produce

injury or death within minutes and achieve their effects with small amounts of the agent. Nerve agents are absorbed rapidly and the effects are felt immediately upon entry into the body. You will be issued the nerve agent antidote kit MARK I, each containing two autoinjectors (clipped together - two to a kit), which should be carried in the inside pocket of your mask carrier.

When you recognize the signs and symptoms of nerve agent poisoning, you should quickly put on the protective mask and then inject yourself with one dose of the antidote. You should inject yourself in the outside (lateral) high muscle, or for a very thin soldier, the upper, outer part of the buttocks (lateral buttocks).

Symptoms of Nerve Agent Poisoning

The symptoms of nerve agent poisoning are grouped as early symptoms, (those symptoms which you experience yourself (self-aid)), or severe symptoms (those symptoms which require your assistance (buddy-aid)).

Early Symptoms (Self-aid)

- Unexplained runny nose.
- Unexplained sudden headache.
- Excessive flow of saliva (drooling).
- Tightness of chest, creating breathing difficulties.
- Muscular twitching of exposed/contaminated skin.
- Stomach cramps.
- Nausea.
- Difficulty seeing (blurred vision).

Severe Symptoms (Buddy-aid)

- Strange and confused behavior.
- Gurgling sounds produced when breathing.
- Severely pinpointed pupils.
- Red eyes with tearing.
- Vomiting.
- Severe muscular twitching.
- Loss of bladder/bowel control.

- Convulsions.
- Stoppage of breathing.

First Aid for Nerve Agent Poisoning

Self-aid.

- Step 1. Put on protective mask.
- Step 2. Remove one nerve agent antidote kit from the mask carrier.
- Step 3. Hold the set of injectors by the plastic clip with the big injector on top at eye level (where you can see it).
- Step 4. Grasp the smaller auto injector with the thumb and two fingers of the free hand.
- Step 5. Pull the injector out of the clip with a smooth motion.
- Step 6. Form a fist around the auto injector.
- Step 7. Place the green (needle) end of the injector against your outer (lateral) thigh muscle, or if you are a thinly built individual, place injector against the upper, outer (lateral) part of your buttocks.
- Step 8. Apply firm even pressure to the injector until it functions by pushing the needle into your thigh muscle.
- Step 9. Hold the injector in place for at least ten seconds.
- Step 10. Carefully remove the auto injector.
- Step 11. Place the used injector carefully (watch out for the needle) between two fingers of the hand holding the clip.
- Step 12. Pull the larger injector out of the clip and inject yourself the same way as before, holding the black (needle) end against your outer thigh, or if you are a thinly built individual place the injector against the upper outer (lateral) part of your buttocks.
- Step 13. Drop the clip without dropping the used injectors.
- Step 14. Attach the used auto injectors to your clothing.
 - Push the needle of the used injectors (one at a time) through the left pocket flap of your protective overshirt.
 - Bend the needle to form a hook.

Step 15. Wait 10-15 minutes after giving yourself the first set of injectors. If you are still experiencing any of the symptoms (unexplained runny nose, sudden unexplained headache, drooling, stomach cramps, nausea, or difficulty breathing or seeing), or if symptoms recur, give yourself the second set of injections.

CAUTION

If, within 5 minutes after the administration of any set of injections, your heart beats very rapidly and your mouth becomes very dry, DO NOT give yourself another set of injections.

Step 16. Wait 10-15 minutes after giving yourself the second set of injections. If you are still experiencing any of the symptoms, or if symptoms recur, give yourself a third set of injections.

CAUTION

DO NOT give yourself more than three sets of injections of antidote.

Step 17. Seek medical aid if symptoms persist after giving yourself three sets of injections.

Buddy-aid

Step 1. Mask the casualty.

- Move (roll) the casualty from whatever position he/she is in onto his/her back (face up).

- Open the casualty's mask carrier and remove the protective mask.

- Situate yourself near the casualty's head.

- Squat near the casualty's left shoulder, facing his/her feet.

CAUTION

DO NOT KNEEL. If you kneel, the action may force the chemical agent into or through your protective clothing.

- Open the mask.

- Grasp the mask with your thumbs outside the cheek pouches and your fingers inside (the cheek pouches).

- Spread the mask open and position it on the casualty's chin.

Lift the casualty's head and slide the head harness over it as follows:

- Position thumbs through the two bottom straps of the head harness.
- Cup the casualty's head with the fingers of both hands and lift slightly.
- Move thumbs back and down behind the casualty's ears.
- Make sure the head pad is centered in the middle of the back of the head.

Check for a complete mask seal by covering the mask's inlet valves. The mask will collapse if properly fitted, indicating a good seal.

Pull the protective hood over the head, neck, and shoulders of the casualty.

Step 2. Administer the antidote injections.

- Position yourself near the casualty's left thigh; this will make it easier to reach into the casualty's mask carrier.

- Remove one nerve agent antidote kit from the inside pocket of the casualty's mask carrier.

- Hold the set of injectors by the plastic clip with the big injector on top in front of you at eye level (where you can see it).

- Grasp the Atropine (small) auto injector with the thumb and first two fingers of the free hand.

- Pull the injector out of the clip with a smooth motion.

- Form a fist around the auto injector.

- Place the green (needle) end of the injector against the casualty's outer thigh muscle. For thinly built individuals, re-position casualty onto his/her side or stomach and inject the antidote into the upper buttocks.

- Apply firm even pressure to the injector until it functions by pushing the needle into the casualty's muscle.

- Hold the injector in place for at least 10 seconds.

- Remove the autoinjector.

- Place the used injector carefully (watch out for the needle!) between two fingers of the hand holding the clip.

- Pull out the large injector and inject the casualty the same way as before, holding the black (needle) end against the casualty's outer thigh or upper buttocks.

- Drop the clip without dropping the used injectors.
- Attach the extended autoinjectors to the casualty's clothing.
- Push the needle of the used injectors (one-at-a-time) through the pocket flap of the casualty's protective outer garment.
- Bend the needle to form a hook.

CAUTION

DO NOT stick yourself with the needle.

Step 3. Immediately repeat the above steps using the second and third kits, nerve agent antidote, MARK I.

Step 4. Decontaminate the casualty's skin.

VOMITING AGENTS

Vomiting agents produce a strong pepper-like irritation in the upper respiratory tract with irritation of the eyes and tearing. They cause violent uncontrollable sneezing, coughing, and vomiting, and a general feeling of discomfort. The principal agents in this group are: diphenylchlorasine (DA), diphenylaminearsine chloride (adamsite, (DM), and diphenylcyanarsine (DC). They are dispensed as aerosols and produce their effects by inhalation or by direct action on the eyes. When concentrated, DM smoke is canary yellow; DA and DC smokes are white. All become colorless when diluted with air. Low concentrations of these agents are effective and may not be detected at the time of exposure.

Protective Measures. Your protective mask provides adequate protection against vomiting agents. Should you become exposed to these agents, protective overgarments are not necessarily required to be worn.

Symptoms.

- A feeling of pain and sense of fullness in the nose and sinuses.
 - Severe headache or burning sensation in the throat.
 - A feeling of tightness and pain in the chest.
 - Irritation of the eyes and tearing.
 - Uncontrollable coughing, sneezing, and salivation.
 - Nasal secretion (runny nose) accompanied by pronounced nausea and vomiting.
 - Mental depression may occur during the progression of these symptoms.
- Mild symptoms caused by very low concentration resemble those of a severe

cold. The onset (start) of symptoms may be delayed for several minutes after initial exposure, especially with DM. However, you may be effectively exposed to the agent long before the smoke is suspected and/or detected.

- Symptoms of exposure to field concentrations of vomiting agents usually reach their climax in 5 to 10 minutes and completely disappear with 1 to 3 hours. However, DEATH can occur if an individual is exposed to high concentrations in a confined space.

- Symptoms have a tendency to increase in severity for several minutes after masking, thus giving the impression that your mask is ineffective. Should this occur, remove your mask only under self-controlled conditions and only to accomplish those self-aid measures.

Self-aid. If exposed to vomiting agents:

- STOP breathing and put on mask.
- If available, crush one chloroform capsule in a wad of cotton or handkerchief and push saturated material inside mask. Chloroform will provide instant relief from these symptoms.
- If eyes, face, or other exposed skin areas become contaminated, follow procedures as described before.
- If vomiting occurs, follow procedures as described for toxins. If necessary, rinse your mouth with water, but do not swallow.

TEAR AGENTS (CS or CN)

Should you be exposed to a tear agent before masking, it can cause an increased flow of tears and intense eye pain. It may irritate the upper respiratory tract. If you mask after exposure, be sure to clear your mask and keep your eyes open as much as possible. Recovery from the tear agent effects will be spontaneous.

If heavy skin contamination occurs in a hot, humid, or closed environment, blistering may result unless the agent is rinsed from the skin with water. If the agent in liquid or solid form has entered your eyes, force your eyes open and flush them with water.

INCAPACITATING AGENTS

Generally speaking, an incapacitating agent is any compound which can interfere with the performance of military duties by affecting the central nervous system and by producing muscular weakness and abnormal behavior. It is likely that such agents will be disseminated by smoke-producing munitions or aerosols, thus making breathing their means of entry into the body. The use of the protective mask is, therefore, essential for protection against agents.

There is no special first aid to relieve the symptoms of incapacitating agents. Supportive first aid and physical restraint may be indicated. Weapons and other potentially harmful materials should be removed from the possession of individuals who are suspected of having these symptoms. This includes cigarettes, matches, medications, and small items which might be swallowed accidentally. Delirious persons have been known to attempt to eat items bearing only a superficial resemblance to food.

Anticholinergic drugs (BZ type) may produce alarming dryness and coating of the lips and tongue; however, there is usually no danger of immediate dehydration. Fluids should be given sparingly, if at all, because of the danger of vomiting and because of the likelihood of temporary urinary retention due to paralysis of bladder muscles. An important medical consideration is the possibility of heatstroke caused by the stoppage of sweating. If the environmental temperature is above 78° F, remove excessive clothing from the soldier and dampen him/her to allow evaporative cooling and prevent dehydration. If the soldier does not readily improve, apply first aid measures for heatstroke and seek medical attention.

Individuals may be exposed to toxic substances in everyday activities or on the battlefield. Learn to identify the signs and symptoms and take immediate first aid measures to reduce or eliminate the effects of the substance. Medical personnel will not always be readily available to provide first aid. Your quick response can make the difference between life and death for yourself and for your fellow soldiers.

Current doctrine on treatment of chemical/biological agent casualties encompasses medical evacuations only when absolutely necessary. When exposed to sub-lethal doses of nerve agent for example, the affected soldier may not be able to perform primary tasks; for instance, a TOW gunner who relies wholly on the ability to see to track targets. Nerve agents may severely impair the soldier's vision to the point he/she cannot effectively employ the weapon system. However, this individual may recover, probably sooner than a replacement can be sought or obtained.

Consider having 10 percent or more of your unit stricken with sub-lethal exposure of chemical agent. To evacuate this large a number would severely cripple the unit's ability to accomplish its mission. As the supervisor, it is your responsibility to consider the possibility of evacuating chemical/biological casualties from the battlefield in conjunction with organic medical personnel. If the decision is made to evacuate, you, as the supervisor, must expedite that mission.

CHARACTERISTICS OF BIOLOGICAL AGENTS

On every battlefield, the soldier has to fight disease as well as the enemy. Disease has proven to be a formidable antagonist, determining the outcome of many battles. Prior to the development of modern medicine, disease killed more soldiers than did actual combat. This was due to overcrowding, poor camp hygiene, inadequate medical support, and the physical stresses of combat. World War II was the first war in the history of the US Army where deaths from

combat exceeded those from disease. But death from disease is not the only problem. The fighting strength of the US Army in World War II was significantly weakened by lost man-days due to sickness. In World War II, the number of lost man-days due to naturally occurring disease was equivalent to 18 US Army infantry divisions operating for a 3-year period.

The military potential of disease has not been overlooked. If naturally occurring disease can have a major military impact, how much greater could that effect be if disease-producing microorganisms were employed intentionally? Biological operations are not new. The popular notion was that foul odors and decaying material could cause disease. In the Middle Ages, this misconception led to the hurling of corpses and excreta into besieged cities by means of an immense machine called a trebuchet. A more sophisticated approach was used by the British against the Indians at Fort Pitt, Pennsylvania in 1763. The British commander infected the local Indian tribe with smallpox by giving them blankets taken from smallpox patients. The Indians had a low biological resistance to the disease and many died.

In the 20th century there have been numerous allegations about the use of biological agents. There is one case which is supported by substantial evidence. During World War I, Germany used the causative agent, glanders, to infect French and Romanian cavalry horses. Biological agent research was also active in Germany and Japan during the 1930s. The threat that this biological research posed to the Free World was evaluated in the United States by the National Academy of Sciences. Their study determined that "the value of biological warfare will be a debatable question until it has been clearly proven or disproven by experiences. The wide assumption is that any method which appears to offer advantages to a nation at war will be vigorously employed by that nation. There is but one logical course to pursue, namely, to study the possibilities of such warfare from every angle, make every preparation for reducing its effectiveness, and thereby, reduce the likelihood of its use". The report led to the development of the US Army biological defense research program in 1942.

The ultimate objective of biological operations is to directly or indirectly reduce a target population's ability to wage war. This objective might be achieved directly by attacking you. It also might be achieved indirectly by attacking your crops, domestic animals, or supplies, thereby limiting your means of support.

General Characteristics of Biological Agents

Biological weapon systems are technically feasible. They possess a mass casualty potential which cannot be safely ignored. It is imperative to be able to defend against biological attack. The first step in preparing a sound defense is to understand the nature of the threat. This involves sweeping away some of the misconceptions associated with biological agents. These agents are not the ultimate weapons referred to by science fiction writers. Knowledge of the general characteristics of biological agents and toxins enables the soldier to place their threat in perspective.

Low Agent Requirement. Biological weapon systems are unique in that the agents involved are alive. Only a small number of microorganisms are needed to establish infection. The agents reproduce in the host to bring about disease. A natural regional outbreak of a disease which affects many a individual and spreads rapidly is called an epidemic. In such a situation there is an unusual increase in the number of cases of a disease in a limited time among a limited population. In nature, the spread of disease occurs from direct contact between individuals, contact with or ingestion of excreta and contaminated food, exposure to dusts and mists of infective material (aerosols) and from transmission by animal or anthropod vectors. Following large-scale dissemination of a biological agent, an initial outbreak of disease of epidemic proportion might occur. This depends upon the contagiousness of the agent, the presence or absence of favorable environmental conditions, and the level of medical support. Epidemics among any group can be controlled or minimized by sanitation, immunization, quarantine, and treatment. Rapidly spreading epidemics are not considered to be the likely result of a biological attack in a civilized country, so long as, controlling factors remain at a high level of efficiency.

Large-Area Coverage. Biological weapon systems have the potential to cover larger areas than other weapons. Extremely large numbers of infective doses of biological agents can be of small volume because of the microscopic size of the organisms. A single delivery vehicle can cover target areas up to thousands of square kilometers with a casualty-producing biological agent aerosol.

Dependence on Weather. There are four significant weather conditions which directly affect a biological agent aerosol. These are sunlight (ultraviolet radiation), relative humidity, wind (both speed and direction), and air stability. Ultraviolet radiation is lethal to most biological agents; therefore, most biological attacks may be expected at night. Each potential biological agent, once aerosolized, has an optimum relative humidity requirement for survival. Therefore, the degree of variance from the optimum, influences the rate of decay of an aerosol. However, there are some potential biological agents that are not significantly influenced by the relative humidity when in an aerosol form. The importance of wind effects varies with the type of weapon system used to disseminate the agent. If dissemination is by a weapon that releases the agent directly on target, then wind direction and speed have little effect on the target coverage; however, downwind effects from the target must be considered. If dissemination is by a weapon that releases the agent upwind of a target area, then the wind must carry it to the target area. Normally, the most effective wind speeds for effective target coverage with a biological agent aerosol involving downwind travel are from 8 to 18 knots.

Delayed Effect. Biological agents do not cause casualties immediately. Time is required for the agent to reproduce. After the microorganisms have multiplied in sufficient quantity, they may overcome the body defenses and cause disease. There is a period of time from the time of entry into man to the time he is actually sick and becomes a casualty. This period of time, "exposure-to-casualty" (incubation period) is specific for each agent and varies from a few days to a few weeks or even months.

Pervasive. The particles of biological agent aerosols are so small and light that they are carried by wind currents or insects (vectors) into dug-in positions, fortifications, or other shelters and structures. So-called hard targets for other weapon systems would not be considered hard targets for biological weapon systems. It is possible that the dose received inside a nonairtight structure may exceed that received on the outside. This is true because the structure, once penetrated, affords protection for the agent and it will probably persist for a much longer period of time.

Nondestructive. Since biological agents (other than antimaterial agents) affect only living things; equipment, facilities, and structures will be left intact by a biological attack. In addition, explosive biological munitions use very low order explosives for dissemination of the agent. Such explosions are not of sufficient force to produce any significant destruction. Spray weapon systems are completely nondestructive.

Difficult to Detect. Biological agents that are disseminated as aerosols are not detectable by any of the five physical senses (sight, smell, taste, touch, and hearing). When you come in contact with such an aerosol, you inhale the organisms without suspecting you have been the target of an attack. Effects do not occur immediately, so the attack goes unnoticed. It is only with special instruments that the presence of biological agents can be detected. At present, the capabilities of such instruments are very limited.

Decay of Agent. Biological agents are living microorganisms, they are affected by environmental conditions during storage, shipment, and dissemination. Refrigeration is necessary during storage and shipment to reduce the loss of viability and strength of the agent. The rate at which most microorganisms die off is predictable and is referred to as the "decay rate".

Easy to Produce. Biological agents are the least expensive of the mass casualty weapons. Any enemy nation with a modest biological research or production base, such as in the pharmaceutical or brewing industry, could produce biological agents.

Severity of Effects. Effects can be either lethal or nonlethal (incapacitating). Lethal or killing agents can produce death in susceptible individuals, but from a practical standpoint, death occurs only in a percentage of those exposed. The nonlethal pathogenic agents usually do not kill but might produce infection or disease which disables susceptible individuals. Food and industrial products can be rendered unsafe or unfit for use by contamination or by the effects resulting from contamination with biological agents.

General Characteristics of Toxins

Generally, a poison produced by microorganisms, vegetables, or animals is called a toxin. True toxins are protein which are more or less unstable, and require a period of incubation or a latent period to produce symptoms.

Once a toxin-producing pathogen has entered the body, the various toxins can disrupt the delicate chemical balance within the body's cells and a disease can result. These toxins can be broadly classed into two types depending upon their composition, resistance to heat, and method of release from the producing organism.

Exotoxins. Exotoxins are proteins of varying molecular weight. Their primary action is upon the digestive tract. These toxins produce severe nausea, vomiting, and diarrhea, but the possibility of death is remote. Man normally acquires these heat-stable toxins following ingestion of contaminated food.

Endotoxins. Endotoxins, a protein complex, are synthesized by the cell membrane and become a part of the cell wall of the microorganism. Since this toxin is part of the cell wall, it can only be released upon death. The Rickettsiae which causes typhus fever produces an endotoxin which causes the rapid destruction of the red blood cells resulting in bleeding.

Recognize a Biological Attack

Although biological agents are used on different targets to produce varying effects on the targets, the ultimate objective of Threat use of biological agents is to reduce the ability of US forces to fight. This objective may be accomplished by killing or incapacitating troops and/or by creating food and supply shortages.

Living germ or microorganism type biological weapons systems (for example, bacteria, viruses, rickettsiae, fungi) are unique in that the agents involved are alive. If used by the Threat forces, these agents will probably be used primarily in a straight role to attack support troops at rear area installations or to destroy plant and animal resources.

Only a small number of microorganisms are needed to establish infection. The agents reproduce in the host body to bring about disease. Large-scale dissemination of a biological agent may cause an outbreak of disease of epidemic proportions. An epidemic is an unusual increase in the number of cases of a disease in a limited population. How great the epidemic is depends upon the contagiousness of the agent, the presence or absence of favorable environment conditions, and the level of medical support.

Types of Biological Agents. Biological antipersonnel agents are those which are effective directly against humans and are selected on the basis of their ability to cause or disability through disease. Biological antipersonnel agents may include bacteria, rickettsiae, viruses, or fungi. Bacteria can cause such diseases in humans as scarlet fever, meningococcal meningitis, gonorrhea, anthrax, syphilis, and salmonella food poisoning.

Rickettsiae are parasites that produce diseases such as typhus fever and spotted fever. Viruses cause diseases such as influenza, rabies, smallpox, yellow fever, infectious hepatitis, mumps, and measles. Fungi cause diseases that may resemble influenza in milder cases, or chronic infections involving all organs of the body.

Several diseases transmitted by microorganisms begin in animals and are transmitted to humans. Others are caused by insects or contaminated water or food. Still others are transmitted by direct contact with infected persons.

Symptoms of Biological Agents. Unlike symptoms of chemical agents, biological agents symptoms may not appear for days following an attack. The incubation period makes it important for soldiers to be alert for any signs of illness in their unit, especially if an unusual number of soldiers begin to display symptoms of illness. There also will be an increase in the sick call rate. These symptoms may indicate that a biological attack has occurred.

Factors that Influence the Effect of Biological Agents. In most cases, the normal healthy body is capable of overcoming the invasion of small quantities of disease-producing microorganisms. However, the body's defenses are a relative matter, it is generally expected that they will not be able to overcome the mass invasion of disease germs likely to be encountered during biological attack by Threat forces. Some of the factors involved in the infection of individuals by biological agents are the route of entry of the agent into the body, the body defenses available to fight the agent at the time it enters the body, and the effectiveness of the agent at that time.

Toxins. Toxic biological weapon systems are non-living, poisonous, chemical compounds which are produced synthetically or by germs, animals, or plants. Toxins can produce the same symptoms as nerve, blister, choking, and blood agents and in any combination of effects. Operationally, they behave in much the same way as chemical agents. Because of these characteristics, it is expected that the enemy may use toxins in a tactical situation.

There are no rapid detection/warning devices currently fielded for biological weapon system defense. Therefore, the soldier must rely on intelligence warning, or the recognition of the patterns of attack.

Suspect a biological attack if:

- Low-flying aircraft appear to produce a mist or spray.
- Ammunition is delivered by enemy aircraft that has no apparent explosive impact.
- Unusual bomblets are found.
- Numerous, unexplained, ill personnel or animals are in the area.
- Unusual amounts of vectors (for example, lice, ticks, fleas, and mosquitoes) are present or vectors that are not normally abundant in the area of operations.

Toxins

Toxins are alleged to have been used in recent conflicts. Witnesses and victims have described the agent as toxic rain (or yellow rain) because it was reported to have been released from aircraft as a yellow powder or liquid that covered the ground, structures, vegetation, and people below it.

Protective Measures. Individual protective measures normally associated with persistent chemical agents will provide you protection against toxins, i.e., the wearing of the protective mask with hood; overgarment ensemble, gloves and booties; and implementation of mission oriented protective posture level-4 (MOPP 4).

Symptoms. The symptoms associated with toxins may include any/all of the following:

- Dizziness.
- Severe itching or tingling of the skin.
- Formation of multiple, small, hard blisters.
- Coughing of blood.
- Shock and/or death.

Self-aid. Upon recognition of an attack employing toxins or the onset (start) of symptoms listed above, you must immediately take the following actions:

Step 1. STOP BREATHING and put on your protective mask with hood and protective clothing.

Step 2. Should severe itching of the face become unbearable, quickly:

- Loosen the cap on your canteen.
- Remove helmet. Take and hold a deep breath and remove mask.
- While holding your breath, quickly, close your eyes and flush your face with generous amounts of water.

CAUTION

Do not rub or scratch your eyes or let the water run onto your clothes or protective overgarments.

Step 3. Put on, reseal, clear, and check mask.

NOTE

The effectiveness of the M258A1 skin decontamination kit is unknown at this time; however, flushing the skin with large amounts of water will reduce the effectiveness of the toxins.

Step 4. If vomiting occurs:

- Saturate a piece of cloth or handkerchief with water.
- Remove your mask and hold the dampened cloth over your mouth and nose.
- Breathe through the dampened cloth and attempt to control vomiting. If necessary, rinse your mouth with waer, but do not swallow.

Step 5. After having brought vomiting under control, put on, reseal, clear, and check mask; fasten hood.

Medical Assistance. If you suspect that you have been exposed to toxins, you should seek medical assistance immediately.

SCREENING SMOKES

Titanium Tetrachloride (FM) Smoke. This smoke is relatively nontoxic, but the liquid burns the skin like a strong acid. The smoke is irritating to the nose and throat, but only mildly so, at the concentration usually found in a smoke cloud. The protective mask should be worn in heavy concentratiions of FM. Flush any liquid FM from the skin with water.

Sulfur Trioxide-Chlorosulfonic Acid Solution (FS) Smoke. Smoke of this solution causes a prickling sensation on the skin because of the minute acid particles of which it is composed. Liquid FS is highly corrosive to the skin. Splashes of liquid FS in the eyes produce extremely painful acid burns. Exposure to heavy concentration or prolonged exposure to ordinary concentrations may cause severe irritation of the eyes, the skin, and the respiratory tract. The protective mask should be worn in high FS smoke concentrations. Flush any liquid FS from the skin and eyes with water.

HC Mixture (HC). High concentrations of this smoke encountered near an operating munition, in an inclosed space, or near dense HC smoke screens, and in ordinary field concentrations for a prolonged period may have a sufficient amount of zinc chloride built up to produce toxic effects. The protective mask should, therefore, be worn. The effects of exposure to HC may include irritation of the nose and throat, coughing, choking, headache, fever, chest and muscular pains, and suffocation. If nausea, vomiting, or difficulty in breathing occurs, get medical aid as soon as conditions permit. Aspirin will ease general discomfort.

Oil Smoke. Inhalation of oil smoke produces no apparent symptoms immediately even though it is inhaled for extended periods. Operating personnel exposed to prolonged high concentraions of oil smoke should wear protective masks as much of the time as possible since the development of pneumonia may occur with prolonged breathing of smoke.

White Phosphorus (WP) Smoke. This smoke is harmless in normal field conditions; however, injuries from burning solid or liquid WP are serious. These burns heal very slowly.

Incendiaries

Incendiaries can be grouped as white phosphorus, thickened fuel, metal, and oil and metal. You must learn to protect yourself against these types of incendiaries.

- White phosphorus (WP) is used primarily as a smoke producer but can be used for its incendiary effect to ignite field expendients and combustible materials. The burns from WP are usually multiple, deep, and variable in size. When particles of WP get on the skin or clothing, they continue to burn until deprived of air. They also have a tendency to stick to a surface and must be brushed off or picked out.

Should burning WP strike you, proceed as follows:

Step 1. Smother the flame by submerging yourself in water or by dousing the WP with water from your canteen or any other source. Urine, a wet cloth, or mud can be used. Copper sulfate pads, if available, can be moistened and put over the burning WP. The copper sulfate reacts chemically to coat the phosphorus particles and to prevent further activity. You may be able to take off contaminated clothing quickly before the phosphorus burns through to the skin.

NOTE

Since WP is poisonous to the system, grease or oil should NOT be used to smother the flame because the WP will be absorbed into the body with the grease or oil.

Step 2. Keep the WP particles covered with wet material to exclude air until you can remove them or get them removed from your skin.

Step 3. Remove the WP particles from the skin by brushing them with a wet cloth and by picking them out with a knife, bayonet, stick, or similar object.

Step 4. Report to a medical facility for treatment as soon as your mission permits.

- Thickened fuel mixtures (napalm) have a tendency to cling to the clothing and the body surfaces, thereby producing prolonged exposure and severe burns. The first aid for these burns is the same as for other heat burns. The heat and irritating gases given off by these combustible mixtures may cause lung damage, which must be treated by a medical officer.

- Metal incendiaries pose special problems. Thermite and thermate particles on the skin should be immediately cooled with water and then removed. Even though thermate particles have their own oxygen supply and continue to burn under water, it helps to cool them with water. The first aid for these burns is the same as for other heat burns. Particles of magnesium on the skin burn quickly and deeply. Like other metal incendiaries, they must be removed. Ordinarily, the complete removal of these particles should be done by trained personnel at a medical treatment facility, using local anesthesia. Immediate medical treatment is required.

- Oil and metal incendiaries have much the same effect on contact with the skin and clothing as those discussed above.

IMPLEMENT MISSION-ORIENTED PROTECTIVE POSTURE (MOPP)

CONDITIONS

Given a directive to implement a specific MOPP level, protective masks, and clothing for you and your soldiers.

STANDARDS

Soldiers are wearing the appropriate clothing for the MOPP level specified and all clothing and equipment is properly fitted.

PERFORMANCE MEASURES

1. Tell your soldiers to put on the proper protective clothing and equipment for the designated MOPP level. The MOPP level will normally be set by your chain of command. However, if your unit is attacked with chemical agents without warning, go immediately to MOPP 4.

MOPP LEVEL	OVERGARMENT	OVERBOOTS	MASK/HOOD	GLOVES
0	STOWED(NOTE A)	STOWED(NOTE A)	CARRIED	STOWED(NOTE A)
1	WORN (NOTE B)	CARRIED	CARRIED	CARRIED
2	WORN (NOTE B)	WORN	CARRIED	CARRIED
3	WORN (NOTE B)	WORN	WORN (NOTE C)	CARRIED
4	WORN CLOSED	WORN	WORN CLOSED	WORN

NOTE A - ITEMS WILL BE STOWED NEARBY FOR READINESS

NOTE B - OVERGARMENT WORN OPEN OR CLOSED BASED UPON THE TEMPERATURE

NOTE C - HOOD WORN OPEN OR CLOSED BASED UPON THE TEMPERATURE

Check yourself and your soldiers to be sure that:

a. All soldiers are wearing the right clothing and equipment for the designated MOPP level.

b. At MOPP levels 3 and 4 protective masks fit properly and are sealed.

c. Protective clothing fits properly.

REFERENCES:

FM 21-3, TASK 031-503-3008

MISSION-ORIENTED PROTECTIVE POSTURE

Threat forces have the capability to employ chemical and biological agents and are willing to do so. Protective clothing and equipment are used to counter this threat through Mission-Oriented Protective Posture (MOPP). MOPP is a flexible system of protection against chemical and biological agents which is used to facilitate mission accomplishment. It requires the soldier to wear individual protective equipment consistent with the chemical threat, the work rate imposed by the mission, and the temperature. Individual protective clothing is a standard issue item.

It is the corps and higher-level commanders' responsibility to direct MOPP 0 and MOPP 1 and recommend the higher MOPP levels appropriate to the threat. They are aware of the strategic tactical intelligence that might indicate the probable use of NBC weapons. Ordering MOPP 2 through MOPP 4 is the responsibility of division and lower-level commanders. The ultimate responsibility, however, is that of the company commander. At this level there is a better appreciation for what the unit can and cannot do. The commander increases or decreases the unit's protective posture based on an analysis of the situation and guidance from higher command. Final responsibility at this level retains the flexibility the system provides.

MOPP does not mean that individuals must wear all of their protective equipment all of the time. In fact, because of duty requirements, body heat buildup, and basic human needs, protective clothing and equipment cannot be worn for an indefinite period. MOPP levels give the commander and staff a range of choices of chemical protection for their units, from no protection at all to full protective clothing and equipment. The ideal situation is to be able to determine a balance between the need for chemical protection and the work rate required by the mission. This ideal balance will minimize both chemical and heat casualties. Unfortunately, the ideal will usually be difficult to achieve.

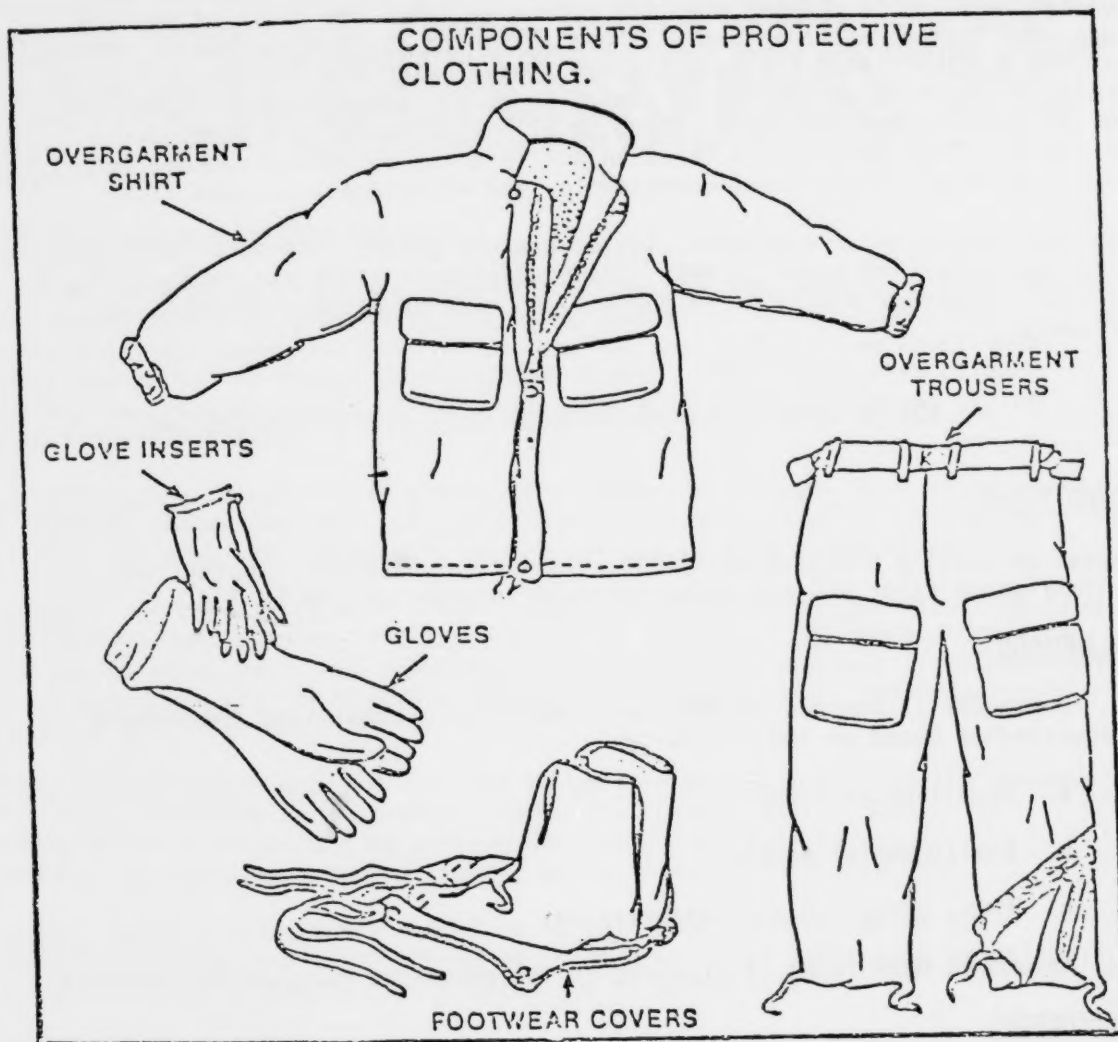
All combat operations are conducted under the Mission-Oriented Protective Posture system. Of course, if there is no threat, there is no protection requirement; this is called MOPP 0. At the other extreme, when there is a continuing, immediate threat and the Threat force has a capability to produce an unacceptable casualty level among unprotected troops, they may be required to wear protective clothing and equipment for extended periods.

The chemical protective overgarment ensemble is permeable clothing. It is normally worn over the duty uniform. The overgarment consists of one coat (also called a shirt) and one pair of trousers. Both are expendable. The shirt and trousers are made of two layers of material. The outer layer is made of nylon cotton. The inner layer is charcoal-impregnated polyurethane foam. Some charcoal will be deposited on clothing worn under the undergarment. This will not detract from the chemical characteristics of the overgarment.

The shirt has a short stand-up collar and a full-length zipper opening covered by a double protective flap. The cuff of the sleeves has elastic closures. Two outer pockets are located at chest level. The trousers have two pockets and a fly-front with a protective flap. The waist has adjustable tabs plus suspenders and belt loops. Each leg has a zipper closure on the lower outside section. The overgarment is available in eight sizes: xxx-small, xx-small, x-small, small, medium, large, x-large, and xx-large. When sizing the overgarment, remember that it is worn over the duty uniform. The overgarment is packaged in a vapor barrier bag. This bag protects the overgarment from possible contamination due to moisture; petroleum, oil, and lubricants (POL) products; and solvents. General instructions and a sizing chart are printed on the bag. The overgarment provides protection to the soldier exposed to vapors, aerosols, and small liquid droplets of nerve and blister agents. The protective capabilities start with the opening of the vapor barrier bag and continues for up to 14 days, or until the overgarment becomes contaminated. When contaminated, the overgarment gives the soldier a minimum of 6 hours of protection before it must be discarded.

The footwear covers are loose-fitting impermeable rubber. They have a non-slip sole. There are two models: one uses four eyelets to lace around the foot, the other uses five eyelets. The footwear covers are one-size-fits-all. They can be worn on either the right or left foot. The footwear covers are issued in a plastic bag with two pairs of laces and an instruction sheet. The footwear covers provide protection to the soldier from all known field concentrations of chemical agents. This protection is provided for a minimum of 14 days starting with the first day of wear. If the footwear covers are in good condition, they can be decontaminated and reused.

The protective gloves are issued as a set. The glove set consists of an outer glove and an inner glove to assist in absorption of perspiration. The outer gloves are made of an impermeable, black butyl rubber. The inner gloves are a thin, white cotton glove which can be worn on either hand. The gloves are available in four sizes: small, medium, large, and x-large. The gloves are issued in a plastic bag with an instruction sheet. The gloves provide protection to the soldier exposed to vapors, aerosols, and small droplets of chemical agents. This protection is good for a minimum of 14 days, starting with the first day of wear. Gloves in good condition can be decontaminated and reused. The standard issue leather gloves can be worn over the protective gloves. It is important to wear leather gloves when handling rough objects. This will protect the protective glove from punctures and tears. During cold weather operations cold weather mittens can be worn over the protective gloves. Contamination of the leather gloves or cold weather mittens will require the soldier to discard these items and be issued replacements.



When preparing for an NBC attack, particularly a chemical attack, checking your individual protective equipment for serviceability and completeness is critical to prevent becoming a casualty. If in a MOPP posture that requires wearing the chemical protective overgarment, ensure that there are no rips, tears, or broken zippers. Also, check the footcovers and gloves, whether worn or not worn. Avoid coming into contact with petroleum products such as gasoline, oil, or diesel fuel to prevent breaking down the protective

qualities of the overgarments. Minimize getting the overgarment wet by wearing a poncho or wet weather gear. When traversing dew moistened terrain or fording streams, efforts should be directed to prevent pant legs from getting wet. Although data is not available to specify the degradation of the overgarment when wet, the commander should be advised that the protective qualities have been reduced and efforts initiated to secure additional overgarments to be changed when the commander feels the risks of wearing degraded protective overgarments is not warranted for the successful completion of the mission. When overgarments are contaminated and the possibility of soldiers becoming wet during an operation exist, added concern is merited. Until data becomes available, changing of overgarments is a commander's decision. That decision is based on the threat, logistical support (short term and long term), operational commitments, and willingness to take risks.

In addition to the overgarment, footcovers and gloves, the term "MOPP gear" includes other individual items. These additional items are necessary for a soldier to assume a protective posture and must be checked by small unit leaders.

ADVISE COMMANDER ON MISSION-ORIENTED PROTECTIVE POSTURE

CONDITIONS

Given personal protective equipment, mission requirements, weather data, intelligence data, and contamination data information IAW FM 3-4.

STANDARDS

1. Commander is advised on MOPP level options in completing the mission requirements based on the following:
 - a. Condition of troops.
 - b. Environmental factors.
 - c. Enemy situation and capabilities.
2. Recommend MOPP level is provided to the commander considering standard 1.

REFERENCES

STP 3-54E2, SM, Task 031-506-2053 (TBP)

USE OF MOPP

The most critical aspect of supervising the protection of personnel in your unit is being able to advise the commander on a MOPP level consistent with the mission and the threat. Being prepared in the correct MOPP level before the

attack will significantly reduce casualties and allow continuation of the assigned mission.

All combat operations are conducted under the mission-oriented protective posture system. Of course, if there is no threat then there is no protection requirement, but this is still a MOPP. At the other extreme, when there is a continuing, immediate threat of chemical attack and the threat force has a capability to produce an unacceptable casualty level among unprotected troops, they may be required to wear protective clothing and equipment for extended periods. In this case, some form of safe area must be provided so that troops can perform necessary functions that require the removal of some or all of the protective gear.

MOPP Flexibility-Limiting Factors

With the publication of FM 3-4, the MOPP system has been made more flexible. MOPP levels should be ordered at the lowest practical level. Captains, lieutenants, and sergeants will often have the best information about local conditions to set or change existing MOPP levels. The flexibility of MOPP provides for varying levels of individual protection but is limited by the factors described below.

Heat Exhaustion. Individuals operating at moderate to heavy work rates while in chemical protective gear, may experience heat exhaustion (dizziness and fainting) at any time, especially during periods of high temperature.

Fatigue. Individuals in MOPP 4 will tend to experience fatigue resulting from such factors as mask breathing resistance, increase in body temperature from work energy/solar heat, and psychological/physiological stress. This condition of fatigue increases the need for rest and sleep to maintain individual alertness and efficiency.

Senses. Individuals who are required to perform duties involving the senses or related functions such as manual dexterity, visual acuity, and voice communication will operate at varying decreased levels of efficiency, depending on training and proficiency, while in full protective gear.

Personal Needs. Individuals cannot be in full chemical protection for indefinite periods and still attend to certain personal needs such as eating, caring for wounds, shaving, and elimination of body wastes.

Considerations for MOPP

You, as the primary advisor to the commander on NBC related matters, will be required to give recommendations to the commander as to the appropriate MOPP for a particular mission. The commander's general guidance for the use of protective clothing and equipment should be stated in the SOP. This SOP should also define the levels of MOPP in detail as they will be used in that unit and what items of protective equipment are required for each level and how they are to be used.

When the commander gives planning guidance for a particular mission, the commander may specify variations on the MOPP levels and any such variations from the SOP are published in the coordinating instructions of operations orders and plans.

Your evaluation of the unit's possible courses of action to accomplish the mission must consider the commander's guidance, the inherent degradation of the unit's capability to perform the mission in increasing MOPP levels, and acceptable numbers of casualties from chemical agents, heat buildup, and conventional munitions. In determining what MOPP to recommend, you must evaluate the type of mission and its relative importance to the overall mission. When the mission is analyzed in relation to chemical protection, the following questions must be answered before MOPP is established.

- a. What work rate does the mission involve?
- b. What will the temperature be during the mission?
- c. Can the mission given to subordinates be changed or modified to achieve similar results with an increase in protection or a decrease in risk?
- d. The chemical threat? Part of the threat is the capability of the threat forces to employ chemical agents and the probability that they will do so. Information on this capability and probability may be provided through intelligence channels or may be based on previous experience. It also encompasses the capability of a unit to survive in a chemical environment.

You must consider if the chemical threat could prevent the accomplishment of the mission, cause temporary modification of the mission, or cause the commander to accept the possibility of more heat casualties to prevent excessive casualties from chemical agents. If the commander does allow the troops to reduce their protection, the risk of increased numbers of chemical casualties must be accepted. The number and severity of these casualties will depend on the alertness of the troops, adequacy of the warning and alarm systems, elapsed time between the attack and subsequent personal decontamination, and adequacy of first-aid treatment.

Reduced chemical protection of troops should not be permitted unnecessarily because the risk of heat stress, or even exhaustion, normally involves only a brief illness, whereas chemical casualties can be much more serious. It should be realized that most cases of heat exhaustion will recover within a few hours. Heat stroke and chemical casualties may not recover or will be incapacitated for much longer periods. Heat stroke has a 50 percent mortality rate but it accounts for only a very small percentage of all heat casualties. Heat exhaustion can be considerably reduced by command emphasis on making certain that troops are in excellent physical condition and drink enough water.

The support required to minimize casualties from all causes and the estimated time to complete the mission must be carefully studied. The time needed to perform most tasks will be increased when troops are required to wear full protective gear. This fact must be accepted and included in the planning. Performance degradation will be discussed at length later.

The Effects of Environmental Factors such as Temperature and Wind Speed:

a. Temperature directly affects body heat buildup, especially when wearing protective clothing. This buildup, in turn, directly affects the unit's ability to accomplish its mission. High temperature, on the other hand, severely curtails the MOPP options.

b. Wind speed has an effect in that high winds decrease the probability that the enemy will employ chemical agents and thus allows the commander the opportunity of designating a lower MOPP level. Winds also aid in the dissipation of body heat when troops are able to open or partially remove their protective clothing.

The Physical Needs of the Soldier

In using the MOPP system you must also consider the physical needs of the troops, such as eating, drinking, sleeping, elimination of body wastes, bathing, shaving, and changing clothes. The wear of protective clothing and equipment creates unique problems in these areas.

Feeding. The feeding of personnel in a chemical environment depends primarily on the type and extent of the contamination. Some of the available options are as follows:

a. If the unit is in a contaminated area where there is also a vapor hazard, feeding must be done inside some sort of collective protection, if any is available. An expandable van truck, such as the M291A2 with the M14 collective protection equipment, or the M51 collective protection shelter could be used for this purpose. Since any available shelter will probably have a small capacity, the commander will have to establish a rotational system, feeding small elements of the unit and rotating in other elements until the entire unit is fed. FM 3-4 specifies entry and exit procedures for collective protective shelters. Units with collective protective shelters should include these procedures in their unit SOP.

b. If the unit is located in an area that is heavily contaminated and no collective protection is available, it may be necessary to withdraw troops to a nearby safe area or to a rear area for feeding. This could be done on a rotational basis but could also be done by a unit replacement system. The method used would be highly dependent on the situation, the distance involved, and the availability of an uncontaminated area.

c. If the unit is located in a contaminated area but there is no detectable vapor hazard or is in an uncontaminated area but under constant threat of chemical attack, feeding can be done in the open but should be done on a rotational basis allowing about 25 percent of the unit to unmask at one time. In all of these situations, it is imperative that great care is taken to ensure that the food has not been contaminated with chemical agents.

Drinking Water. Troops equipped with certain types of the M17-series protective masks use the drinking device while in a contaminated area.

Normally, drinking from and refilling the canteen in an area contaminated with a chemical agent that does not present a vapor hazard can be done with only minor decontamination of the canteen cap and the water spigot areas.

In more hazardous areas, the commander must make arrangements for the delivery of filled canteens with the caps on in exchange for empty ones that are collected in the contaminated area. The empties must then be decontaminated thoroughly before refilling.

Sleeping. Personnel should sleep in full chemical protection and under cover whenever possible.

Personnel Identification. The wear of chemical protective clothing and equipment makes normal identification of personnel difficult. Each unit should devise an expedient method of making identification easier. One such method is the wearing of color coded tape for the personnel of each platoon of a company.

CAUTION

Never place tape on the overgarments because it breaks down the protective quality. Markings must not be placed on the overgarment for the same reason.

Defecating and Urinating. A decontaminated area should be provided, if possible, for troops to use for the elimination of body wastes. They should also be instructed in the methods of opening, closing, and removing of contaminated protective clothing to prevent contamination of underclothing or exposed skin.

Shaving, Bathing and Changing Clothes. Personnel must be provided with a means of shaving, bathing, and changing clothes when operating for extended periods in a contaminated environment. A CLOSE SHAVE IS NECESSARY TO ENSURE A GOOD SEAL FOR THE PROTECTIVE MASK. Bathing and changing clothes are essential for troops to maintain personal hygiene.

ADVISE COMMANDER ON PERFORMANCE DEGRADATION

CONDITIONS

Given a simulated situation where you are to supervise two or more soldiers dressed in MOPP 4 performing a specific task in 20°F, 50°F, or 85°F (-6°C, 10°C, or 29°C) temperatures and the requirement to advise the commander on performance degradation.

STANDARDS

The commander is advised on performance degradation IAW Appendix A, Performance Degradation Data in FM 3-4.

REFERENCES

FM 3-4, Appendix A
STP 333-54E2 SM, Task 031-507-3012 (TBP)

MOPP ANALYSIS

You have learned the different MOPP levels and items that needed checking when supervising the implementation of MOPP. You learned how to advise your commander on what MOPP level was needed based on the threat and unit mission. In this lesson, you will learn how to advise the commander on the performance degradation of assigned missions when conducting operations in MOPP level 4.

Every commander has a responsibility to go through a MOPP analysis based on the particular situation. This analysis establishes a balance between reducing the risk of casualties and accomplishing the mission. The use of MOPP involves balancing the risk of casualties from chemical or biological attacks against the need for higher mission performance provided by low MOPP levels. As a minimum, the following nine questions must be considered in the analysis before a decision is made.

1. How likely is it that the unit will be attacked with NBC weapons?

The answer is an intuitive judgement based on knowledge of the way NBC weapons are used. First, there is the matter of the unit location on the battlefield. For example, is the unit close to the front lines? Can mortars and artillery deliver chemicals accurately? Remember, the closer the unit is to enemy observers, the more accurate and timely enemy fire is likely to be. Is the unit considered a primary target in the rear area? Persistent agents are more likely to be used in the rear to disrupt operations that support the front line.

2. How much warning of an enemy NBC strike can be anticipated?

Available intelligence should be considered. Consider each of these questions: Has the enemy been using NBC weapons? Has the enemy deployed weapons systems? Do wind direction and speed place the unit in a downwind hazard area? If so, consideration should be given to the placement of the unit alarms. What is the lay of the land and the wind direction? Are the alarms stationed upwind in locations that might give some early warning? Has there been any unexplained illness in adjacent units?

3. What types of mission has the unit been given?

The mission will greatly affect the amount of protection that must be worn by each soldier. How important is the mission, and what risks must be taken to accomplish it?

4. What are the weather conditions and how will they influence the unit's performance?

It is known that high temperatures and humidity create conditions that make it difficult for the body to dissipate heat. This is compounded when soldiers are wearing protective clothing, for this makes the body retain even more heat. The more body heat retained, the fewer hours soldiers can work, and the greater their chance of heat exhaustion or heat stroke. This, coupled with the work rate, requires units to take longer and more frequent breaks. Therefore, it takes longer to accomplish the mission.

Wind speed may also be a factor to consider. High wind speeds aid in the dissipation of body heat as well as decrease the probability that the enemy will employ chemical agents.

5. Is it day or night?

The best time to use chemical agents is between late evening and early morning when stable or neutral temperature gradients are prevalent. Under these conditions, agents tend to linger close to the ground and move horizontally with the wind. During unstable conditions, in the heat of the day, agents rise rapidly, reducing the time on target.

6. How well-trained are the troops and what is their physical condition?

Well-prepared troops suffer less stress in MOPP 4 than troops who are less prepared. Well-prepared troops are those who have trained extensively in protective gear and are in good physical condition. It cannot be overemphasized that soldiers must train with their MOPP gear, to include many hours of training in MOPP 4. An infantryman trains extensively with the M16 rifle to become proficient with its use. Likewise, a soldier must continually train with MOPP gear to become more confident of the equipment and learn how to adjust his or her way of working. Soldiers cannot be expected to fight successfully in full MOPP gear if they have not trained with the equipment. Training in full MOPP gear helps soldiers understand the problems they will encounter when required to wear MOPP gear.

7. What work rate will be required to accomplish the mission?

Physical work rate is normally categorized as light, moderate, or heavy. Clerical and administrative tasks and riding in vehicles are examples of light work. Handling supplies and equipment and preparing defensive positions are examples of moderate work. Fighting or forced marching are examples of heavy work. Remember, soldiers performing heavy work-rate tasks tire more quickly. If soldiers are also in full MOPP (MOPP 4), they will not be able to work as hard or as long.

8. How long will it take to accomplish the mission at different levels of MOPP?

Once the commander has answered the questions discussed, he or she can estimate how much time will be needed to accomplish the mission. Unit 6 gives several tables for varying types of units to give commanders an idea of how long tasks will take in MOPP 4. Remember, the tables are only a guide. Accurate times for the unit are obtained only by experience.

Increases in the time needed to conduct operations in MOPP 3 are somewhat less because some body heat can dissipate by opening the hood and overgarment. However, normal work times cannot be achieved until the mask and hood are removed. The head and shoulder areas release most of the body heat, but when retained, this buildup of body heat under the hood contributes to the time require to do a job due primarily to fatigue. Remember, there are no significant time increases for units operating in MOPP 1 and MOPP 2.

9. What additional degree of protection against liquid agent contamination is available to the unit?

Any form of available overhead cover provides additional protection. Depending on the wind speed and type of cover, MOPP levels can be reduced. Sound judgement must be used. The possibility of a percutaneous (through-the-skin) hazard still exists and must be considered. Therefore, it is recommended that soldiers wear as much protection as mission accomplishment allows.

Once these questions are answered, the commander can apply the information toward deciding the amount of protection needed to accomplish the mission. This process must be continuously updated and refined as the situation changes.

OPTIONS IN DETERMINING THE MOPP LEVEL

Based on your recommendations and commander's analysis of the situation, the commander must determine what levels of chemical protection is appropriate so that his/her unit can accomplish its mission in a chemical environment. The tactical implications of wearing the current chemical protective ensemble are clear. Even at cool temperatures there will be performance degradation for tasks requiring delicate work as a result of the decrease of manual dexterity and the touch sensastion while wearing gloves. Vision in the mask, particularly downward vision, is limited, producing problems when moving through jungle or marked areas and in personnel identification.

Speech and hearing are also impeded when wearing the mask and hood. Another nonthermal problem is the breathing difficulty caused by the mask. Tolerance time for troops fighting in protective clothing, even in temperate climates, will be limited by heat stress at temperatures above 21°C (70°F).

Individuals in less than top physical condition, particularly overweight, will have the greatest difficulty in performing their tasks and are more apt to become heat casualties. Unit leaders, who cover more ground in checking on the progress of their soldiers, are also a greater risk unless transportation

can be provided. All of the tabular data presented should be used as a guide only and may be changed based on experience with the abilities of the personnel of a unit to perform under these conditions.

Whenever possible, the commander should specify, before the start of a mission, the MOPP level that individuals will adopt. He/She may later direct that this level of protection be increased, decreased, or varied among individuals or elements within the unit according to his/her evaluation of the current situation and operational limitation. The commander must consider that, as the temperature and work rate increase, the level of individual protection must be reduced, work pacing options must be taken, or he/she must accept the possibility of greater numbers of heat casualties.

One of the options is to reduce the chemical protection according to the temperature and work rate.

Other options are contingent on the hazards of contamination present.

In a contaminated area, the commander may:

- a. Rotate jobs requiring a heavy work rate among subordinate units, elements, or individuals.
- b. Authorize longer and more frequent rest periods.
- c. Provide adequate water supply so that personnel can increase their water intake by frequent drinking of small amounts. Provide water in pre-filled canteens with the M1 canteen cap.
- d. Use vehicular transportation whenever possible.

When there is no immediate hazard from chemical agents, a commander may rotate personnel to various combinations of reduced chemical protection to provide relief from buildup of body heat. The commander may also allow a small percentage of the troops to be out of some or all of their chemical protective clothing at one time.

The number of personnel in reduced protection is determined by the unit commander according to the local situation evaluation.

Reduced protection also is permitted on a selective basis for personnel performing certain tasks requiring manual dexterity, visual acuity, and voice communication.

Reduced protection may also be necessary after considering the long-term psychological effects on personnel in full chemical protective clothing and equipment for extended periods.

When there is no danger from chemical contamination, verified by the use of the unit's chemical agent detector kits, and troops are required to operate at moderate to heavy work rates, the commander may authorize them to progressively reduce their protection by:

- a. Opening the zipper of the hood (and possibly rolling it up) for ventilation.
- b. Remove the protective gloves.
- c. Remove the protective mask and hood.
- d. Open the duty uniform or the chemical protective clothing for ventilation. This will require loosening or removal of external load-bearing equipment.
- e. Remove some or all of the protective clothing.

Finally, the commander has the option of increasing the work times significantly when a job requires a sustained effort for proper accomplishment or is of an emergency nature. It must be noted, however, that troops who are worked continuously for those periods indicated in Unit 6 or FM 3-4, will then require an extended rest (as much as 2 hours or more) to dissipate the built-up heat.

CONDUCT MOPP GEAR EXCHANGE

CONDITIONS

Given the requirement to list, in writing, the steps required to conduct MOPP gear exchange and paper and pencil.

STANDARDS

The steps are listed in proper sequence with 100% accuracy.

PERFORMANCE MEASURES

- Gear drop
- Hood decon
- Overgarment off (Removal)
- Boots and gloves off (Removal)
- Overgarment on
- Boots and gloves on
- Secure hood
- Secure gear

REFERENCE

FM 3-5

MOPP GEAR EXCHANGE

General Guidance

Usually managed by squad size elements. Two soldiers perform this task as a team; squad leader supervision is recommended.

Soldiers are paired into buddy teams. The teams are spaced around a circle with 1 to 3 meters between teams.

A lead team, composed of the squad leader and a companion, direct the exchange from the center of the circle as they go through it themselves.

At any time during the technique, if you suspect you have spread contamination onto your skin or undergarments stop; decon immediately with the skin decon kit, then proceed with the MOPP gear exchange.

The technique begins with a company supply vehicle unloading replacement overgarments and decontaminants. The squad members pick up this material pair up, and form a circle around the lead team. The soldiers alternate as they go through Step 1 gear drop and Step 2 hood decon. The first soldier in each buddy team helps the second soldier do step 1, then the second soldier helps the first soldier do step 1, and so on. At step 3, overgarment off, the soldiers no longer alternate between steps. The first soldier goes all the way through Step 3 through Step 7 (secure hood) before alternating. This is necessary, to ensure no contamination is spread onto skin or undergarments.

Equipment and personnel requirements necessary for MOPP gear exchange

Equipment. Four long-handled scrub brushes per squad, one cutting tool per buddy team, sufficient sizes of MOPP gear for all personnel (overgarment, chemical protective gloves, and boots). For chemical/biological decon: One M258A1 decon kit per person and one 5-gallon container of STB per 12 soldiers.

Personnel. Two personnel from company decon team or the squad leader and assistant are required to set up and supervise the MOPP gear exchange area.

Step 1. Gear Drop. The purpose of this is to remove gross contamination from individual gear (weapon, helmet, load-bearing equipment, and mask carrier) For chemical or biological contamination the gear will be covered with STB dry mix and brushed or rubbed into the material. Gently shake off the excess and set gear aside on an uncontaminated surface. If available, wash equipment with warm soapy water. The materials you will need for this step are four long-handled brushes, one 5-gallon container of STP per squad and, if available, warm soapy water.

Step 2. Boot Decon. The purpose of this step is to remove gross contamination from the mask and hood. Soldier 1 loosens the neck cord and hood straps of soldier 2. For chemical or biological decon soldier 1 uses the M258A1 kit to decon the hood and exposed parts of soldier 2's mask (including

the canister and hose on the M24/M25A1 mask). The mask eyelens outserts should be wiped with decon packet #2 first, followed by decon packet #1 (reverse the usual order). This is required so no residue is left on the lens from decon packet #2. This will not affect the efficiency of the decontamination or cloud the eyelens outsert. When soldier 1 is finished wiping the mask of soldier 2, soldier 1 wipes down his/her own gloves.

Cool, soapy water is not as effective for removing contamination, but can be used if you scrub longer. Soldier 1 then rolls the hood of soldier 2, soldier 1 leaves the zipper closed and lifts the hood straight up off the shoulders of soldier 2 by grasping straps. The hood is pulled over the head of soldier 2 until most of the back of the head is exposed but the hood is not pulled completely over the soldier's face. The straps are reattached to velcro patches, the hood is rolled starting at the chin and working around the mask. It is rolled tightly, but without pulling off the back of the head. Soldier 2 now helps soldier 1 decon and roll his hood. The materials you will need for this step are one M258A1 decon kit per individual, three containers, two sponges, and paper towels or similar drying material.

Step 3. Overgarment Off. The purpose of this is to remove overgarments before chemical agents penetrate through to undergarments or skin. Soldier 1 unfastens the three snaps on the back of the jacket of soldier 2 to include the cord and zipper. Soldier 1 pulls the jacket off soldier 2, one arm at a time, turning the jacket inside out. Soldier 2 should make a fist as each sleeve is pulled off to prevent the gloves from coming off. The jacket is placed on the ground black side up, nearby. It will be used later as an uncontaminated area to stand on while redressing. Next, soldier 1 removes his/her buddy's trousers by first opening the trouser cuffs, then the waist snap, zipper, and, if necessary, the waist tabs. The soldier pulls the trousers off by the cuff, one leg at a time, then places the trousers out of the way. Only one soldier will remove his overgarments at this time. The materials you will need for this step are two containers to hold contaminated trousers (plastic bags are recommended).

Step 4. Overboots and Gloves-Off. The purpose of this is to remove contaminated gloves and boots (footwear covers), to limit the spread of contamination. For overboot removal, soldier 2 stands next to his/her jacket, soldier 1 cuts the overboot strings of soldier 2's overboots. Soldier 1 pulls off the overboots of soldier 2 one at a time; soldier 2 steps onto his jacket. Soldier 2 removes his/her gloves. Soldier 1 assists so that soldier 2 does not touch the outside of his/her gloves with bare hands. The materials required for this step are two containers (to hold contaminated overboots and gloves) and a knife or a pair of scissors (to cut overboot laces). The soldier handling the overboots should decon his/her gloves in case of contact with contamination that might be on the overboots.

Step 5. Overgarment On. The purpose of this step is to restore protective posture. Soldier 1 opens a package of new overgarments but does not touch the garment itself. Soldier 2 reaches into the package and pulls the overgarment out without touching the package. Soldier 2 now puts on the overgarment leaving the cuffs open. The material required for this step are sufficient sized overgarments for all personnel.

Step 6. Overboots and Gloves On. The purpose of this step is to restore protective posture. Soldier 1 picks up a package of clean overboots and opens it without touching the boots inside, soldier 2 reaches into the package and removes the overboots and puts them on. Soldier 1 opens a package of new gloves without touching the gloves inside. Soldier 2 removes them from the package and puts them on. The materials that are required for this step are sufficient sizes of boots and gloves for all personnel.

Step 7. Secure Hood. The purpose of this step is to restore protective posture. Soldier 1 decontaminates his/her gloves with M258A1 skin decon kit. Once the gloves are decontaminated, soldier 1 unrolls the hood of soldier 2 and attaches the straps. Soldier 2 closes all zips and ties on his/her hood and overgarment. At this time the two soldiers will reverse roles and repeat steps 3 through 7. This time soldier 2 assists soldier 1 through the steps.

Step 8. Secure Gear. The purpose of this step is to prepare to return to battle. The soldiers will secure their individual gear, put it back on, and move to the assembly area. The soldiers will use the buddy system to check the fit of all secured gear.

CHEMICAL AGENT DETECTION, IDENTIFICATION, RECONNAISSANCE AND REPORTING

M8 PAPER, CHEMICAL AGENT DETECTOR

M8 detector paper is used to test for liquid toxic agents. The booklet of M8 paper contains 25 sheets of paper colored a slightly brownish, dark gray. Some booklets contain perforated sheets, which doubles the number of available sheets. When a sheet of paper touches a liquid chemical agent, the paper immediately changes color. The paper will turn dark green or black if it touches a V agent. It will turn yellow if it contacts a G agent. If the paper touches a blister agent (H), it turns dark red or purple. Certain G agents will turn the paper a red-brown color. The color changes are immediate.

The inside back cover of the booklet of M8 paper gives instructions for its use. To use the paper; simply tear out a strip of paper, if the paper is perforated, use one-half strip. Lay the paper on a suspected liquid so that the paper just touches the liquid, or secure the paper so that it will detect any liquid agent that falls upon it. The inside cover of the booklet depicts the color changes the paper will undergo if the agent is present.

M8 paper has limitations. It will detect only liquid chemical agents, and some decontaminants will cause color changes similar to those of chemical

agents. Thus, M8 paper should not be relied upon totally. It is one test, but it should be supplemented by other means.

M9 Paper, Chemical Agent Detector. M9 paper is gray-green in color and has an adhesive back. The adhesive back is protected by a white paper backing until dispensed from the roll. The paper is 2 inches (5.1 centimeters) wide and 30 feet (9.1 meters) long. Each roll is contained in a cardboard dispenser equipped with a cutter edge. The dispenser is packaged in a foil-type shipping bag. A resealable plastic storage bag is included for storing the dispenser after removal from the shipping bag.

The detector paper will detect a chemical agent under all types of weather conditions. It is worn by an individual or attached to a vehicle or a piece of equipment. The detector paper indicates the presence of liquid chemical agents. When a liquid chemical agent touches the paper, a pink, red, red-brown, red-purple colored spot appears. The spot may be as small as a pinhead or as large as a dime.

USE THE M256 CHEMICAL DETECTOR KIT

CONDITIONS

Given: An M256 chemical detector kit. Chemical agents are in your area. You are wearing protective clothing and mask.

STANDARDS

Do the steps to check the M256 chemical detector kit and take current readings.

PERFORMANCE MEASURES

1. Check the date on the outside of the kit. Order a new kit of the expiration date is within 6 months.
2. Check inside the kit. If any of the samplers/detectors are damaged or torn, throw them away. If less than five samplers/detectors are in the kit, get a new kit.
3. Take out a sampler/detector. Tear open the protective bag and take out the sampler/detector.
4. Throw away the two pieces of paper between the heater and blister spot.
5. Look at the ampoules marked "3", "4", and "5". If they do not have a liquid inside, throw the sampler/detector away and start over.
6. Pull off tab marked "1".
7. Fold over the white paper tab marked "2". Rub the top of it against the tablet. (You exposed the tablet when you removed the tab in step 6).

8. Hold the sampler/detector so that the test spots are up. Crush all ampoules marked "3" with your fingers.
9. Turn the sampler/detector so that the test spots are lower than the ampoules. Squeeze each ampoule marked "3" so that the liquid runs onto the test spots.
10. Swing hinged heater away from the blister spot.
11. Crush one of the two ampoules marked "4". Swing the heater over the blister test spot.
12. Wait 2 minutes. Swing heater away from spot. Swing hinged protective strip away from spots.
13. Put the sampler/detector in a shady area for 10 minutes.
14. Pick the sampler/detector back up holding it by the hinged protective strip. Crush last ampoule marked "4". Swing heater over the blister test spot.
15. Wait 1 minute. Swing heater away from spot.
16. Hold the sampler/detector so that the test spots are down. Crush the two ampoules marked "5". Squeeze the ampoules to force the liquid onto the test spots.
17. Fold over the white paper tab marked "2". Rub bottom half of it against the tablet. Compare this mark to the first mark. See performance measure 7.
18. Turn the sampler/detector over and read your test results.
19. Report results to your supervisor.

REFERENCES

FM 21-3, Task 031-503-3001

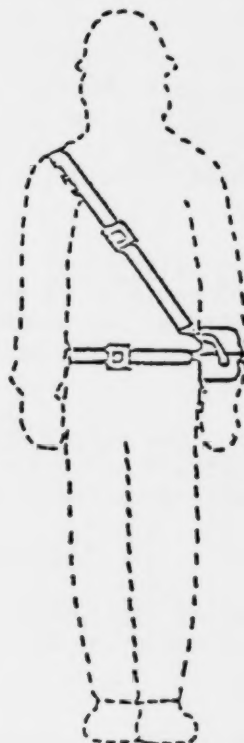
USE THE M256 CHEMICAL AGENT DETECTOR KIT

Once chemical warfare has been initiated, it will be necessary that chemical agents can be detected and identified all the way down to the squad level in order for units to take appropriate actions. In order to use the M256 Chemical Agent Detector Kit, you must be able to state its purpose, capabilities, limitations and components.

The purpose of the M256 Chemical Agent Detector Kit (called the M256 kit) is to detect the presence of chemical agents in liquid and vapor forms. The kit is issued to squad level. It is used in the reconnaissance and monitoring of suspected contaminated areas. It is employed in determining the boundaries of contaminated areas. It is used to determine if it is safe to initiate

unmasking procedures. The kit is also used to detect any contamination that remains on clothing or equipment after they have been decontaminated.

SOLDIER SHOWN CARRYING THE M256 KIT.



Capabilities

The M256 kit can detect the presence of blister, blood, and nerve agents. The kit can detect these agents within 16 minutes plus preparation time. The kit can be used to conduct 12 tests for vapor chemical agents - 1 test for each sampler in the kit.

The M256 kit can detect the following chemical agents:

- Mustards - H, HD
- Phosgene oxime - CX
- Lewisite - L
- Blood Agents - AC, CK
- Nerve agents - V and G

Limitations

The M256 kit can only detect the presence of the agents listed above. It cannot detect choking agents.

Components of the M256 Kit

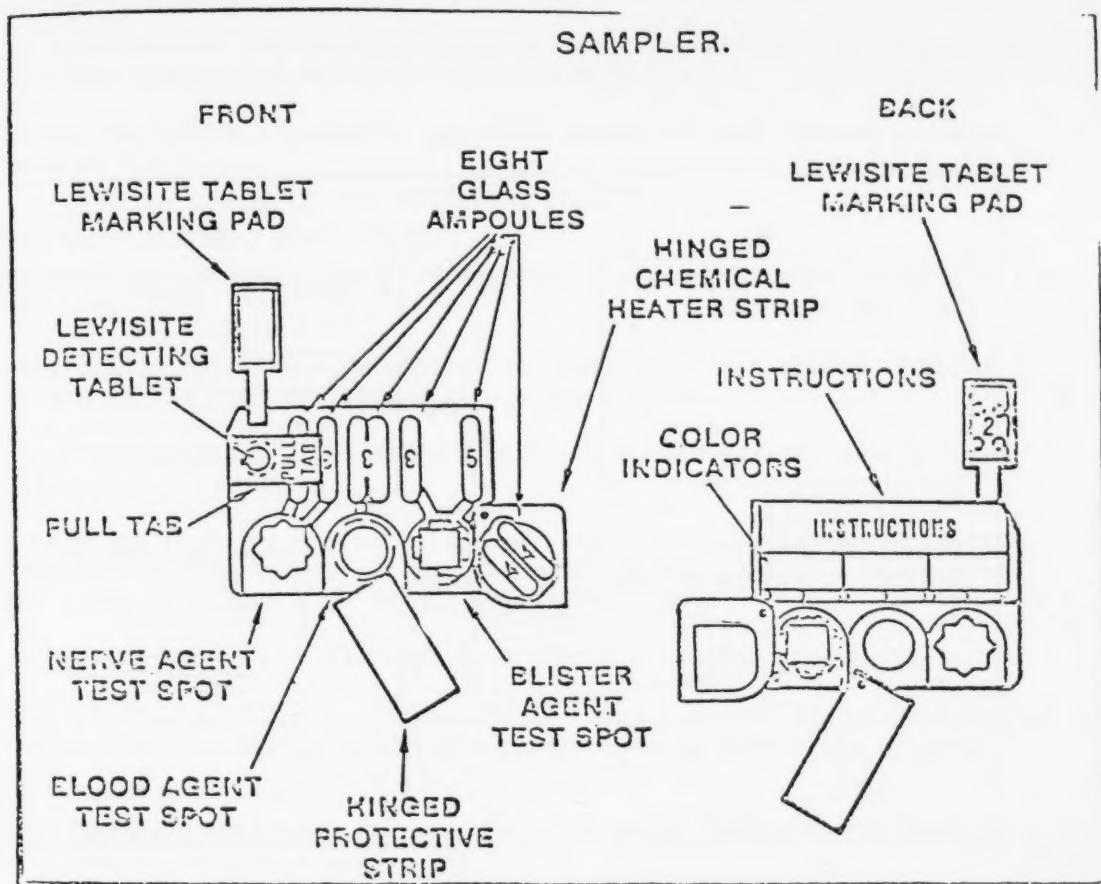
Carrying Case. The case, made of plastic, is 7 inches wide, 3 inches deep, and 5 inches high. An adjustable shoulder strap and waist belt strap enable the kit to be carried over the shoulder and attached at the waist. The top of the case is attached to the bottom by a hinge. A hook and pile fastener tape holds the case securely closed. The discard date and lot number of the kit are stamped on the top.

ABC-M8 VGH Chemical Agent Detector Paper. One booklet of M8 paper is placed inside the kit. The booklet contains 25 sheets of M8 paper. This paper is also contained in the carriers of all protective masks. The M8 paper can detect the presence of liquid nerve and blister agents. It will change color upon contact with these agents.

Operating Instruction Cards. One set of operational instruction cards is attached to the case by a lanyard or cord. These cards contain complete step-by-step instructions for performing tests for chemical agents.

CAUTION

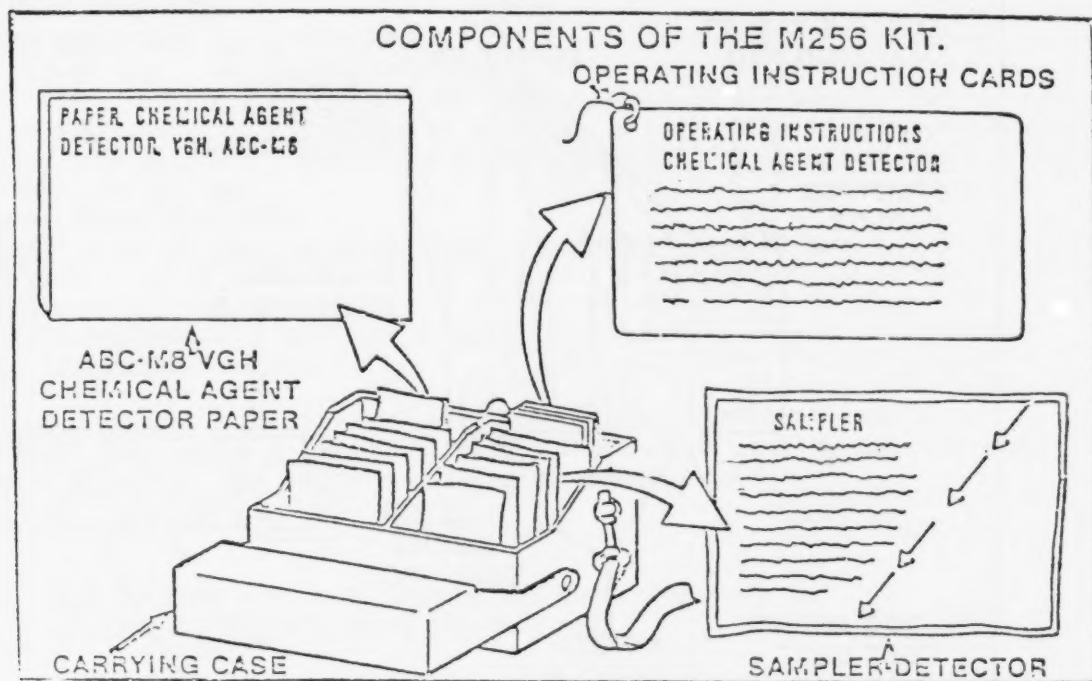
Refer to the operating instruction cards whenever you perform a procedure using the M256 kit.



Sampler-detectors. Each kit is packed with 12 sampler-detectors (called samplers). Each sampler is individually wrapped in a protective bag. The sampler is a small card, approximately 3 inches by 4 inches. On one side are glass ampoules sheathed in plastic, test spots, a chemical heater assembly, a lewisite tablet, and a rubbing tab. On the other side of the card are examples of safe and danger color indications. These help the soldier identify any chemical agents that are present. Each sampler-detector has a lot number and discard date stamped on the protective bag.

Sampler Components

The eight glass ampoules on the sampler are protected by a molded plastic cover. The six reagent ampoules can be crushed inside the plastic, and the reagents can then be channeled to the three test spots. The reagents are substances used to detect chemical agents. When they are absorbed by the test spots, a color change will indicate the absence or presence of harmful amounts of chemical agents in the air. The hinged chemical heater strip is placed over the blister agent test spot to heat the reagent for the blister agent test.



The hinged protective strip protects the blood agent test spot and the nerve agent test spot when they are not in use. The protective strip is also used as a handle for holding the sampler. The pull tab protects the lewisite detecting tablet. The lewisite tablet marking pad is used with the lewisite tablet to detect the presence of lewisite, a blister agent.

The numbers printed on each ampoule and on the back of the lewisite tablet marking pad are sequence numbers. They indicate the order in which the different tests are performed.

On the other side of the samplers are references to the instructions provided and color indicators. The indicators show what colors the test spots should be if different chemical agents are present. They also show what colors the test spots should be if no chemical agent is present. The indicators can be matched against the colors appearing on the test spots to determine if a safe or danger condition exists.

Preventive Maintenance

Once you have learned the purpose, capabilities, limitations, and components, you must learn preventive maintenance of the M256 kit.

To maintain the M256 kit properly, you must inspect it and replace outdated components of the kit.

Inspection Before Use.

- Inspect the carrying case. If a strap is missing or torn, requisition a new kit.
- Inspect the booklet of M8 paper. If fewer than five sheets of paper remain in the booklet, requisition a new booklet.
- Check the samplers. Discard any that are opened or that have discard dates that have passed.
- Repack the usable samplers in the carrying case. Pack them in pairs, side one to side one tear lines at opposite ends. Place a maximum of three pairs on each side of the case.
- Ensure that there are at least five samplers remaining in the kit.
- The operator must notify the supervisor that 6 months or less remains on the sampler, so that a refill kit can be ordered before the discard date.

Inspection During Use. Check the discard date on the samplers. Do not use a sampler if the discard date has passed.

Inspection After Use.

- Again, check the straps on the carrying case. If a strap is missing or broken, requisition a new kit.
- Check components for completeness. Requisition replacements for any expended items.

Before beginning the test for chemical agents in vapor form, you must inspect the protective bag that holds the sampler you intended to use. Are there any punctures, rips, or tears? If so, do not use that sampler. Has the expiration date passed? Again, do not use that sampler. It may give unreliable test results. This could endanger soldiers. They may unmask, thinking that no chemical agents are present.

Preparing the Sampler for Use

The procedure for preparing the sampler for use is performed according to the following steps:

Step 1. Remove the operating instruction cards from the kit. Read the instructions on the three operating instruction cards before proceeding.

Step 2. Remove a protective bag containing a sampler from the kit.

WARNING

Do not use an outdated sampler, because it will give unreliable test indications.

Step 3. Read the instructions on both sides of the protective bag before proceeding.

Step 4. Open the sample protective bag by tearing the bag along the tear line marked with arrows.

CAUTION

Protect the sampler during exposure from excessive moisture, such as rain and dew.

Step 5. Carefully remove the sampler from the protective bag. Retain the protective bag for reference to the instructions written on it.

CAUTION

Do not touch the sampler agent test spots because incorrect test results may be produced.

Step 6. Handle the sampler carefully. Hold the sampler by the hinged protect strip in its closed position.

CAUTION

Keep the hinged protective strip in the closed position to protect test spots.

Step 7. Swing the hinged heater assembly away from the test spot and discard the two loose protective strips under the hinged heater assembly.

NOTE

Disregard the colored beads in the ampoules. They have no function to perform. They were installed during manufacture of the sampler as an aid in identifying the reagent ampoules.

Using the Sampler

The procedure for using the sampler is performed according to the following steps:

Step 1. Pull off and discard the pull tab (marked 1) to expose the lewisite detecting tablet.

Step 2. Bend the #2 TAB over until it contacts the lewisite tablet near the stem of the #2 tab, rubbing it back and forth until a mark is visible.

Step 3. Hold the sampler in the vertical position so that the ampoules are down.

Step 4. Finger-crush the four reagent ampoules in the three center pockets marked with the number 3.

Step 5. Rotate the sampler until the test spots are in a down position. Force the liquid from the four ampoules through the formed channels to the test spots to ensure wetting.

Step 6. Check that the hinged protective strip is over the test spots. Hold the sampler in a horizontal position with the thumb over the center test spot

Step 7. Swing the hinged heater assembly away from the test spot.

WARNING

The heater produces hot vapors and is hot to the touch. Keep away from face and bare skin after the ampoules are broken.

Step 8. Finger-crush one of the two green ampoules marked 4. Immediately swing the hinged heater assembly over the test spot. Vent vapor away from the operator's body. Leave the hinged heater assembly in place for 2 minutes.

Step 9. After 2 minutes have passed, swing the hinged heater assembly and hinged protective strip away from the test spots.

Step 10. Hold the sampler by the hinged protective strip.

Step 11. Hold or emplace the sampler approximately 2 to 3 inches above the ground. Shield the test spots from direct sunlight. Wait 10 minutes.

Step 12. Finger-crush the second green ampoule marked 4. Swing the heater assembly over the test spot. Vent vapor away from operator's body. Leave the hinged heater assembly in place for 1 minute.

Step 13. After one minute has passed, swing the hinged heater assembly away from the test spot.

Step 14. Hold the sampler vertically with the test spots down.

Step 15. Finger-crush the remaining ampoules marked 5. Force the liquid from the two ampoules through the formed channels to the test spots to insure wetting.

Step 16. Rerub the lewisite detecting table with the lewisite tablet rubbing tab. Make sure that the second rub mark is next to the first rub mark. Immediately observe spots for a color difference between the two marks.

Step 17. Immediately turn the sampler over to determine safe or danger conditions. Color comparisons can also be made by the operator using those shown on the operating instruction cards. Wait 3 minutes for nerve agent indications. NOTE: Disregard blue area under nerve spot rim.

Colors That Indicate Danger

Agents are present if color indications on the sampler are as follows.

1. Lewisite is present if the rub mark on the lewisite marking tabd turns olive green.
2. A blister agent is present if the blister agent test spot turns purple/blue (H) or red/purple (CX).
3. A blood agent is present if the blood agent test spot turns pink (weak concentration) or blue (strong concentration).
4. A nerve agent is present if the nerve agent test spot is colorless or peach-colored.

Test for Vapors Above Surfaces Suspected of Being Contaminated With Liquid Agents

There are two ways to perform this test using the M256 kit. Both tests use the sampler. The first test uses available boxes or cans to concentrate the vapors. The second test uses only the sampler.

Use-Available Boxes or Cans. This test is performed in two parts. One part tests for blood agents while the other tests for nerve and blister agents. Both parts can be run at the time if separate boxes or cans and samplers are used. To perform the two parts of the test at the same time, you will need two boxes or cans. (If only one box or can is available, perform Part 1, then Part 2).

PART 1. The test for blood agents is performed according to the following steps:

Step 1. Remove a sampler from the M256 kit. Check it for punctures, rips, or tears. Check its expiration date.

Step 2. Remove the sampler from its protective bag. Hold the sampler by the hinged protective strip in its closed position.

CAUTION

Do NOT touch the sampler agent test spots, because incorrect test results may be produced.

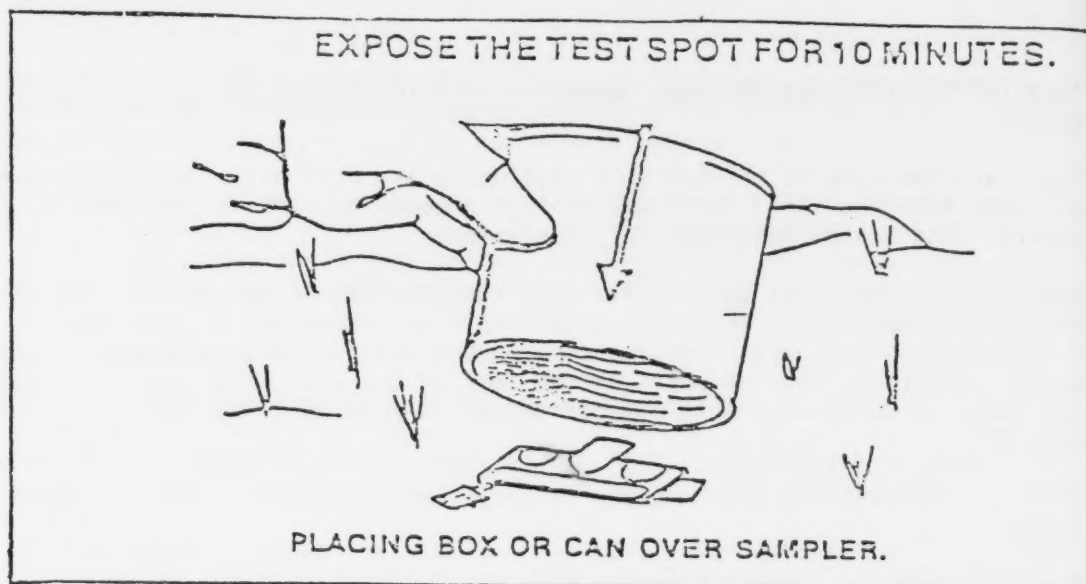
Step 3. Finger-crush only the two ampoules in the center pocket (double pocket marked 3). Do NOT crush the outer ampoules (marked 3).

Step 4. Rotate the sampler, holding the test spots down. Force the liquid from the crushed ampoules through the formed channels to the blood agent test spot to ensure wetting.

Step 5. Swing the hinged heater assembly and hinged protective strip away from test spots. Discard the two loose protective strips of paper under the hinged heater assembly. Swing the heater assembly back over the test spot.

Step 6. Place the sampler with the instruction side up over the suspected area, and place the box or can over the sampler. Expose the spot for 10 minutes.

Step 7. After 10 minutes, remove the sampler and turn it over to determine safe or danger conditions.



PART 2. The test for nerve and blister agents is performed according to the following steps:

Step 1. Remove a second sampler from the kit. Check it for punctures, rips, or tears. Check its expiration date.

Step 2. Remove the sampler from its protective bag and hold it by the hinged protective strip in its closed position.

Step 3. Discard the tab (marked 1) to expose the lewisite detecting tablet.

Step 4. Run the top half of the white paper side of the lewisite tablet rubbing tab (marked 2) on the lewisite detecting tablet. Repeat rubbing until a mark is visible.

Step 5. Hold the sampler in the vertical position so that the ampoules are down. Finger crush the two outer reagent ampoules (marked 3). DO NOT crush the two ampoules in the center pocket (marked 3).

Step 6. Rotate the sampler until the test spots are in a down position. Force the liquid from the two outer ampoules through the formed channels to the blister agent test spot and the nerve agent test spot to ensure wetting.

Step 7. Check the hinged protective strip is over the test spots. Hold the sampler in a horizontal position with the thumb over the center test spot.

Step 8. Swing the hinged heater assembly away from the test spot. Discard the two loose protective strips of paper under the hinged heater assembly.

Step 9. Finger-crush one of the two green ampoules (marked 4). Immediately swing the hinged heater assembly over the test spot. Vent vapors away from the operator's body. Leave the hinged heater assembly in place for 2 minutes.

Step 10. After 2 minutes have passed, swing the hinged heater assembly and hinged protective strip away from the test spots.

Step 11. Place the sampler, with the instruction side up, over the suspected area. Place the second box or can over the sampler. Expose the test spots for 10 minutes.

Step 12. After 10 minutes, remove the sampler from under the box or can. Hold the sampler by the hinged protective strip.

Step 13. Finger-crush the second green ampoule (marked 4). Swing the hinged heater assembly over the test spot. Vent vapors away from the operator's body. Leave the hinged heater assembly in place for 1 minute.

Step 14. After 1 minute has passed, swing the hinged heater assembly away from the test spot. Hold the sampler test spots down.

Step 15. Finger-crush the remaining two outside ampoules (marked 5). Force the liquid from these ampoules through the formed channels to the blister agent test spot and nerve agent test spot.

Step 16. Rub the lewisite tablet rubbing tab (marked 2) on the lewisite detecting tablet next to the first rub mark. Immediately observe for a difference in color between the two marks. If lewisite is present, the tab will turn olive green.

Step 17. Turn the sampler over to determine safe or danger conditions.

Use Sampler Only. When no can or box is available, the normal sampler procedure is used with one exception. After Step 10 of the regular procedure, lay the sampler with the instruction side up on top of the suspected area for 10 minutes. After 10 minutes have passed, continue the procedure as outlined previously to determine if chemical agents are present.

Use the M256 Kit Under Special Conditions

Three types of conditions may affect the procedures for using the M256 kit. These conditions are (1) cold temperatures, (2) high temperatures, low humidity, and (3) high temperatures, high humidity.

In Cold Temperatures. Normal procedures are followed in cold temperatures. Additional steps are added to compensate for the cold, which may freeze the ampoules.

When the Temperature is Below 50°F (10°C). When the temperature is below 50°F, wait 5 minutes before making color comparisons.

When the Temperature is Between -25°F (-32°C) and +32°F (0°C). At these temperatures, the sampler needs to be warmed before use and care taken during the procedure to keep the reagents warm. Perform the normal operating procedures, with these additional steps:

Step 1. Before using the sampler, place the unopened protective bag in a warm area (within a heated shelter or vehicle) for 5 minutes or more to thaw the reagents.

Step 2. Then proceed to open the bag and remove the sampler. If any reagents are still frozen, wait until they are completely thawed.

Step 3. Continue the normal operating procedure for testing for vapors.

Step 4. When you reach Step 11, "Expose the test spots to air", place the sampler outside. Shield it from direct sunlight. Wait 10 minutes.

Step 5. After 10 minutes, bring the sampler into the warm area and wait for any frozen reagents to thaw before proceeding with the remainder of the test.

Step 6. After the reagents have thawed, continue the normal procedure outlined previously.

NOTE

Always protect the sampler as much as possible from snow or rain. Use your body or any available shelter.

In High Temperature and Low Humidity (Desert Conditions). Under desert conditions, the sampler is operated the same as under normal conditions, with one exception. Five minutes after exposure of test spots has started, the nerve agent test spot must be wet again. To do this, squeeze the remaining liquid in ampoule 3 onto the nerve agent test spot.

NOTE

On the blister agent test spot, a faint blue color may appear in the ABSENCE of blister agents H and HD.

In High Temperature and High Humidity (Tropical Conditions). Under these conditions, the color change for lewisite rub marks may be very slight. Compare with a second rub mark before making judgment.

NOTE

On the blister agent test spot, a faint blue color may appear in the ABSENCE of blister agents H and HD.

When a weak blood agent is indicated (pink color change), a second test will be done using only the components needed for the blood agent test.

USE AND MAINTAIN M8 ALARM SYSTEM

CONDITIONS

You are given an M8 alarm system, M229 refill kit, a power source (M10 power supply, BA3517/U or BB501/U, BA3030 battery), a reel of field wire (WD-1), and TM 3-6665-225-12.

STANDARDS

The following must be performed in accordance with TM 3-6665-225-12 and must not cause damage to the equipment:

1. Operator's preventive maintenance checks and services (PMCS) are performed in accordance with Table 3-1.
2. Preoperational procedures are performed in accordance with paragraph 2-6.
3. Pre-startup procedures are performed in accordance with paragraph 2-7.
4. System is started up and operated during usual conditions in accordance with paragraph 2-9.
5. System is operated during unusual conditions in accordance with paragraph(s) 2-14, 2-15, 2-16, 2-17, or 2-18.
6. Continuous use checks and reservicing procedures are conducted in accordance with paragraph 2-10.
7. The system is reactivated following an operational alert in accordance with paragraph 2-12.1
8. System is shutdown for less than 72 hours in accordance with paragraph 2-13b.
9. System is shutdown for more than 72 hours in accordance with paragraphs 5-1 and 5-2.

PERFORMANCE MEASURES

1. Perform operator's preventive maintenance checks and services (PMCS) in accordance with page 3-21, Table 3-1 of TM 3-6665-225-12. Reports deficiencies (if any) to the supervisor.
2. Performs preoperational procedures in accordance with paragraph 2-6 of TM 3-6665-225-12.

3. Performs pre-startup procedures in accordance with paragraph 2-7 of TM 3-6665-225-12.

4. Performs startup and operating procedures in accordance with paragraph 2-9 of TM 3-6665-225-12.

AND/OR

Performs operating procedures under unusual conditions in accordance with paragraph 2-14, 2-15, 2-16, 2-17, or 2-18 of TM 3-6665-225-12.

5. Conducts continuous use-checks and reservicing procedures in accordance with paragraph 2-10 of TM 3-6665-225-12.

6. Reactivates alarm system following an operational alert in accordance with paragraph 2-12 of TM 3-6665-225-12.

7. Performs a shutdown for less than 72 hours in accordance with paragraph 2-13b of TM 3-6665-225-12.

AND/OR

Performs a shutdown for more than 72 hours in accordance with paragraphs 5-1 and 5-2 of TM 3-6665-225-12.

8. Performs all procedures without causing damage to the equipment.

REFERENCES

FM 21-3

Tasks 031-503-2004
031-503-2003
031-503-2005

USE AND MAINTAIN M8 ALARM SYSTEM

The use of chemical agents in warfare is not new. Chemical agents were used in World War I and caused many casualties because the target troops did not expect the attacks, were not trained in defense against chemical agents, and had no means other than their physical senses for detecting an approaching chemical agent cloud.

Since World War I, chemical agents have not been used extensively. There have been reports of the isolated use of them in countries such as Laos, Cambodia, and Afghanistan, but sustained or large-scale use of them has not occurred. This will probably not be the case in any future armed conflict involving nations which pose a threat to the United States.

The United States policy is that US forces will not initiate chemical warfare. Threat forces do not have the same policy. Although their decision to use

chemical agents will be made at the highest political level, they do not have any restrictions against first use of them. In fact, they are prepared to use whatever means are required to win when they go to war. Chemical weapons are routinely included in Threat fire plans. Since potential enemies will probably use chemical agents, and since the United States reserves the right to retaliate, chemical weapons are very likely to be used in future armed conflicts.

Chemical agents are insidious. Most of them are invisible, odorless, and highly toxic in field concentrations. Since they cannot be detected in the field by the physical senses, the damage has often already been done when they are discovered. Since the introduction of chemical warfare in World War I, the insidious nature of chemical agents has been a threat to armies engaged in tactical operations. Until recently, lethal vapors of chemicals could drift into a unit area unnoticed until the effects appeared in personnel. Even well-trained personnel will suffer some casualties from a chemical hazard entering an area undetected.

Recognizing the nature of chemical agents, the Army realized it needed a device that could detect the approach of chemical vapors before they reached an area occupied by personnel. The Automatic Chemical Agent Alarm answers the need for this capability. Though the concept was conceived in the 1950s, the Automatic Chemical Agent Alarm was not placed in active use in Army units until the late 1970s.

The primary purpose of the Automatic Chemical Agent Alarm System is to detect the presence of chemical agents in the air. The Automatic Chemical Agent Alarm System is an automatic miniature chemistry laboratory which continuously samples the air around it and sounds an alarm when it detects nerve agents, blood agents, or choking agents. These types of agents are, in the same order, V o G agents, AC or CK, and CG. The system cannot detect blister agents (H, HD, or HL).

USE OF THE AUTOMATIC CHEMICAL AGENT ALARM SYSTEM

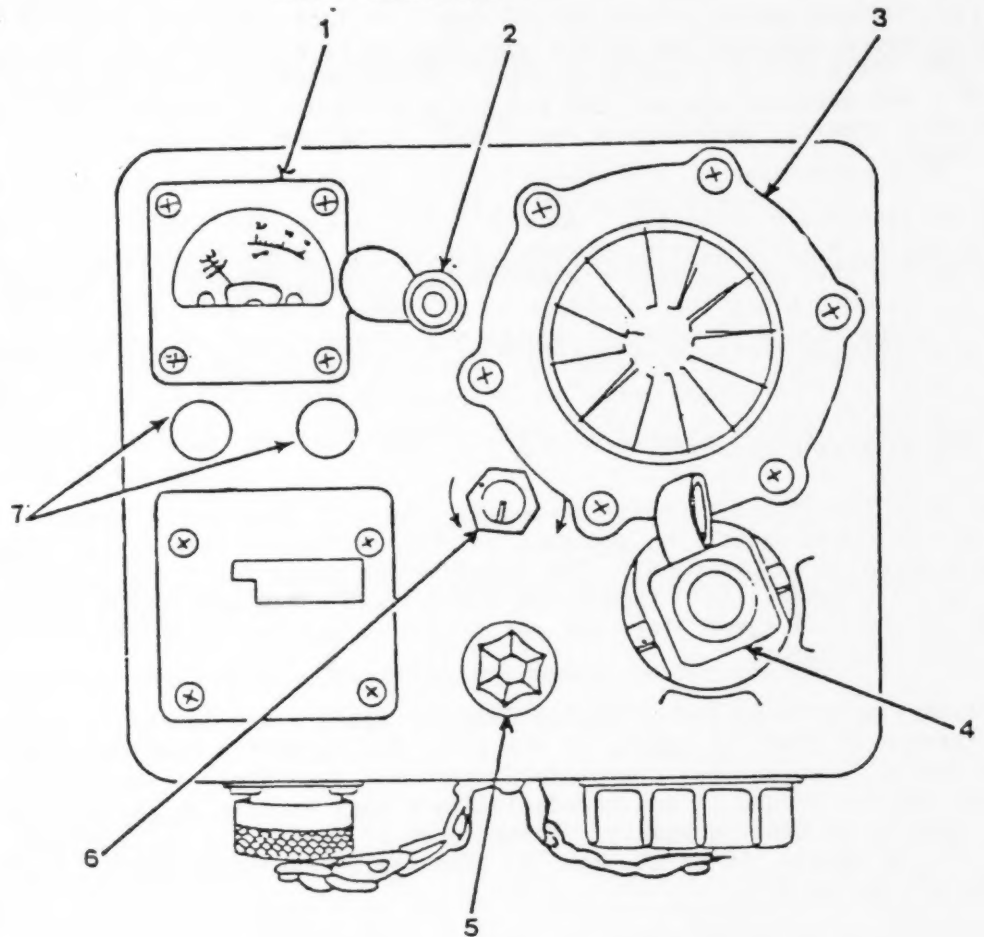
The M8 Automatic Chemical Agent Alarm System consists of the following components:

- M43 Detector Unit
- M42 Alarm Unit

M43 Detector Unit

The M43 Detector Unit senses the presence of chemical agents in the air and produces an audible signal. The M43 Detector Unit consists of a detector unit assembly secured to a bottom case assembly by four clamping catches.

M43 DETECTOR UNIT CONTROLS AND INSTRUMENTS.

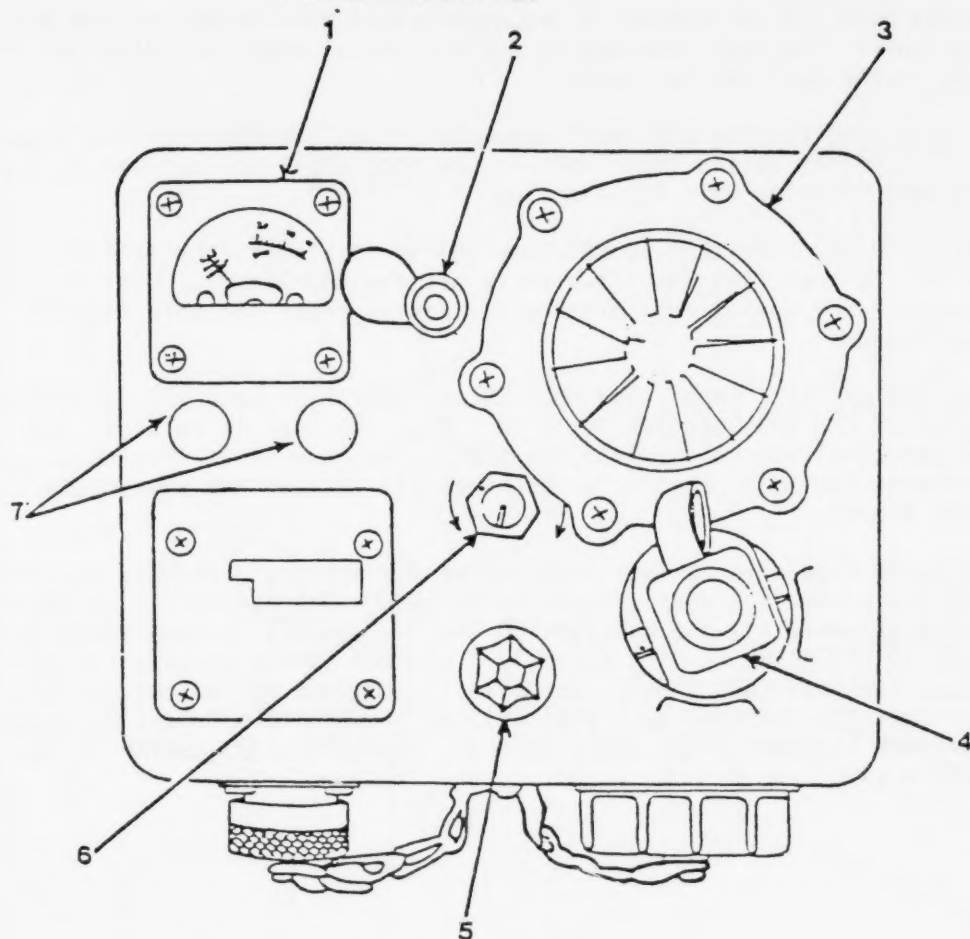


- 1 METER
- 2 HAND CRANK
- 3 HORN

- 4 AIR INLET ASSEMBLY
- 5 ZERO ADJUST KNOB
- 6 HORN VOL-BATTERY TEST KNOB
- 7 REMOTE BINDING POST

Detector Unit Assembly. (Figure on previous page). Attached to the detector unit assembly (6) are: a handle (1), a horn (2), a BATTERY TEST switch and HORN VOL control (3), an AIR INLET assembly (4), a ZERO ADJUST knob (5), an AIR FILTER plug (7), an electrical connector cover (10), two chains (8) that attach the AIR FILTER plug and connector cover, a 24 VDC INPUT receptacle (11), four bottom catches (14), four clamping catches (13), two strap fastener loops (16), an AIR OUTLET cap (15), an identification plate (12), a meter (17), two REMOTE binding posts (18), and a hand crank (19).

M43 DETECTOR UNIT CONTROLS AND INSTRUMENTS.



- 1 METER
- 2 HAND CRANK
- 3 HORN

- 4 AIR INLET ASSEMBLY
- 5 ZERO ADJUST KNOB
- 6 HORN VOL-BATTERY TEST KNOB
- 7 REMOTE BINDING POST

Meter. The meter (1) is located on the top of the unit. It provides a visual indication of the power source voltage when the HORN VOL-BATTERY TEST knob (6) is pressed. Also, the meter is used when setting the ZERO ADJUST knob (5).

Hand crank. The hand crank (2), located on top of the M43 Detector Unit, is used to manually prime the fluid system of the M43 Detector Unit. It has a storage (up) position and an operational (down) position.

Horn. The horn (3) is located in the upper-right-hand corner of the M43 Detector Unit. The horn provides an audible signal when the detection circuits of the unit are activated.

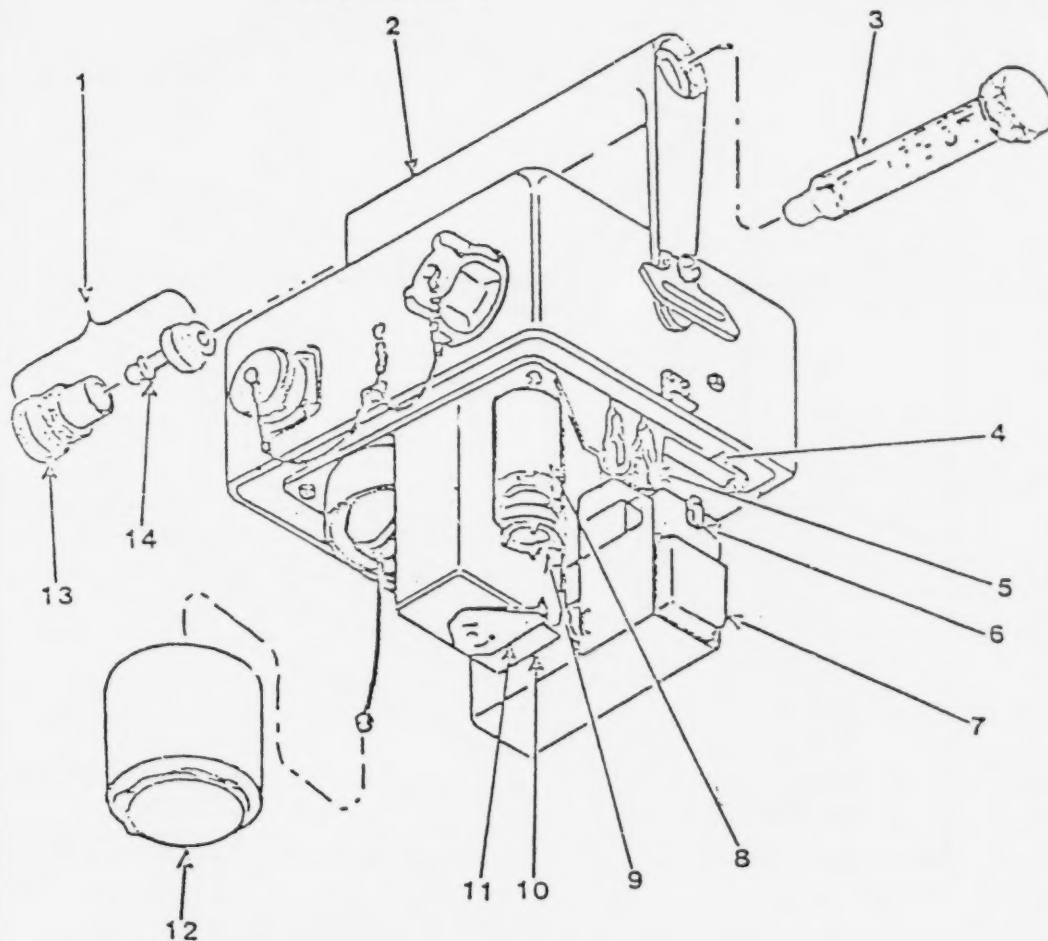
Air Inlet Assembly. The AIR INLET assembly (4) is located near the lower-right-front corner of the top. When in the open position, air can be drawn into the M43 Detector Unit for sampling.

Zero Adjust knob. The ZERO ADJUST knob (5) is located in the center-front portion of the top. The knob is used to set the M43 Detector Unit during preoperational and operational procedures, and to reset the unit after an alert has been sounded.

Horn Vol-Battery Test knob. The HORN VOL-BATTERY TEST knob (6) is located in the center of the M43 Detector Unit top. When the knob is rotated, the horn-output level varies from minimum (LO) to maximum (HI). Pressing in the knob connects the power source to the meter (1) to test the power output of the power source.

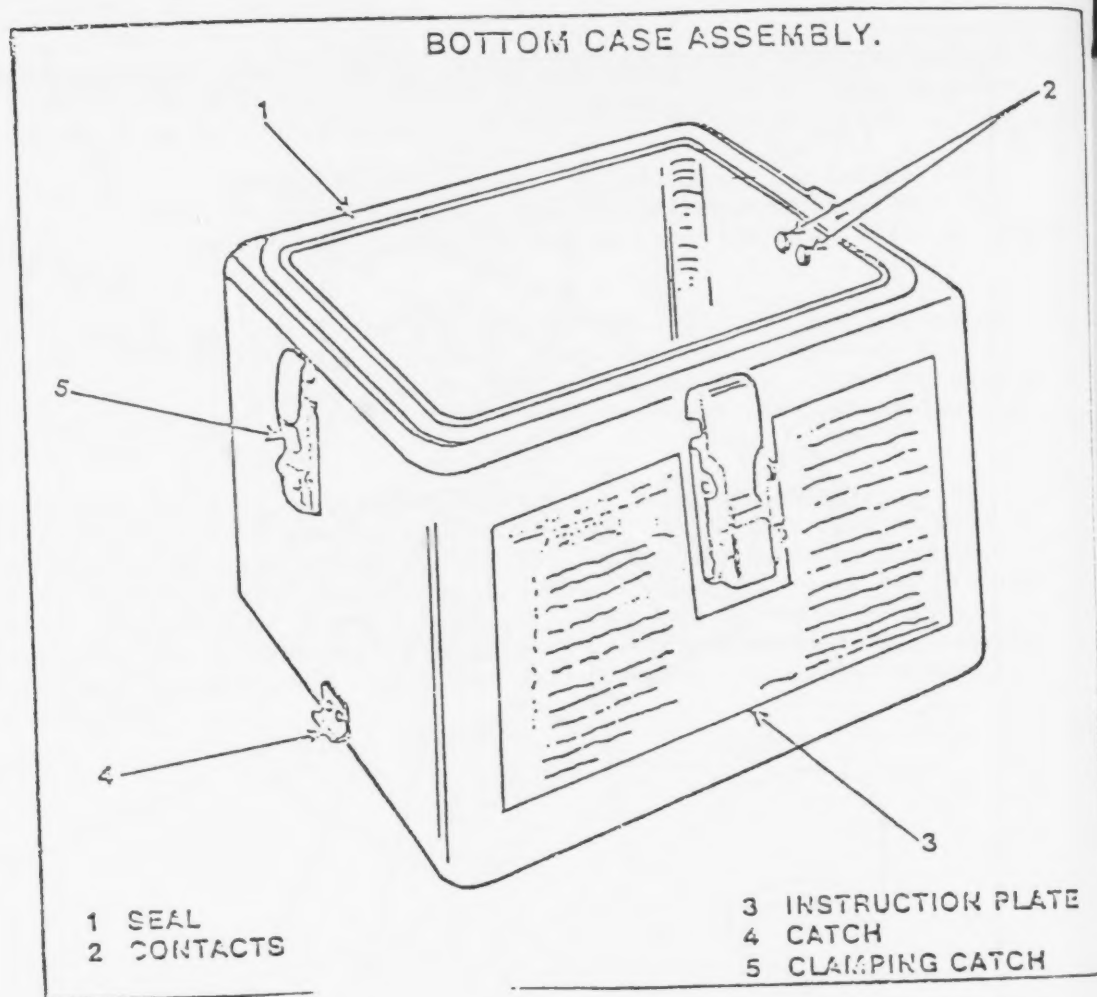
The following figure is an exploded view of the detector assembly to show the parts of the assembly hidden from external view. The handle (2) contains a RAINSHIELD assembly (1) and a FLOWMETER (3). A chassis is mounted to the underside of the detector unit assembly. Mounted to the chassis (4) are four electrical contacts (5), a pump assembly (7), secured by two catches (6), a detector cell (8), secured by a bail (9), an electronic module (10), secured by a turnlock fastener (11), and a reservoir assembly (12), which screws into the chassis (4).

EXPLODED VIEW OF DETECTOR UNIT ASSEMBLY.



- 1. RAINSHIELD ASSEMBLY
- 2. HANDLE
- 3. FLOWMETER
- 4. CHASSIS
- 5. CONTACT
- 6. CATCH
- 7. PUMP ASSEMBLY

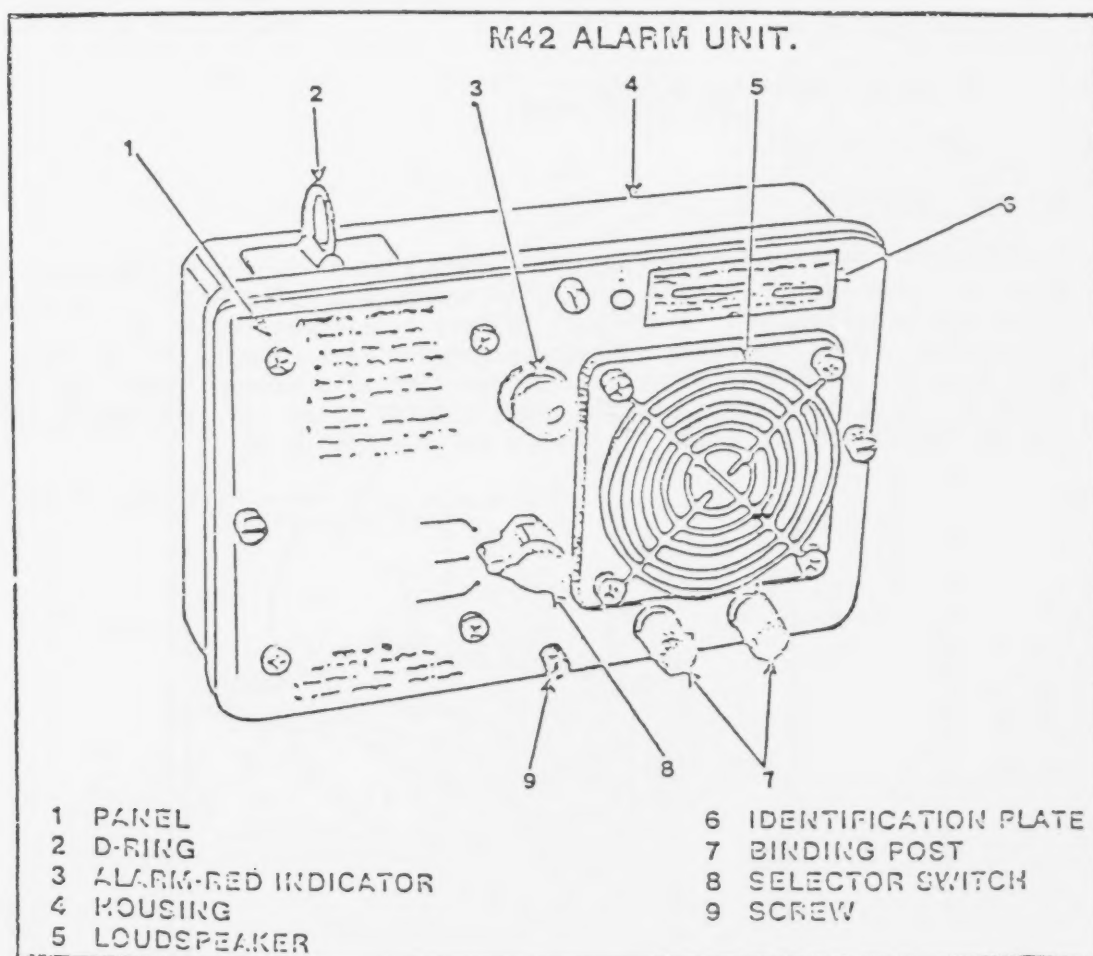
- 8. DETECTOR CELL
- 9. BAIL
- 10. ELECTRONIC MODULE
- 11. TURNLOCK FASTENER
- 12. RESERVOIR ASSEMBLY
- 13. RAINSHIELD
- 14. ADAPTER



Bottom Case Assembly. A seal (1) fits in a groove around the top of the bottom case assembly to ensure that the interior of the M43 Detector Unit is watertight and airtight when the bottom case assembly is secured to the detector unit assembly. Electrical resistance heaters are embedded in the double-walled case of the bottom case assembly. Two pairs of heater contacts (2) mate with contacts in the detector assembly. When the M43 Detector Unit is operated in temperatures below 40°F, the heaters are automatically turned on and off to maintain 40°F within the bottom case assembly. Mounted to the outside of the bottom case assembly are: an instruction plate (3), two catches (4) that attach a BA3517/U battery, and four clamping catches (5) that secure the bottom case assembly to the detector unit assembly.

M42 Alarm Unit

The M42 Alarm Unit, when connected to the M43 Detector Unit, provides a remote audible and visual signal (or visual signal only) whenever the M43 Detector Unit senses the presence of a chemical agent. The M42 Alarm Unit consists of a panel (1) secured to a housing (4) by four knurled screws (9). The panel contains an ALARM-RED indicator (3), a loudspeaker (5), an identification plate (6), two binding posts (7), and a selector switch (8). Two D-rings (2) are fastened to the housing (4). Four BA3030 batteries are secured inside the housing to provide power to the alarm.

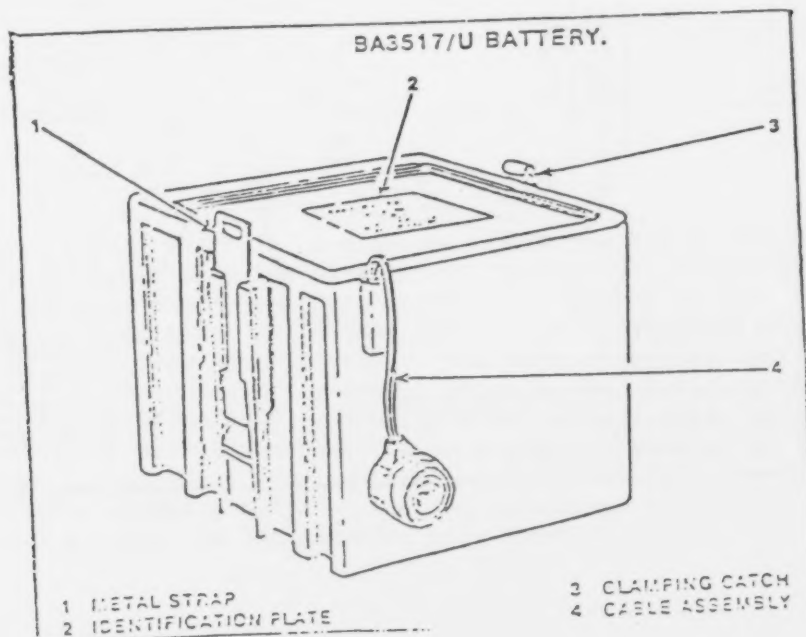


Ancillary equipment available for use with the M8 Automatic Chemical Agent Alarm consists of the items listed below. The equipment required will depend on the method of employment of the alarm.

- Battery, BA3517/U
- M229 Refill Kit
- Power Supply, M10
- Cable Assembly, M168
- Battery, Storage, BB501/U
- High-profile Mount
- Low-profile Mount
- Alarm Unit Mounting Bracket
- Installation Kit

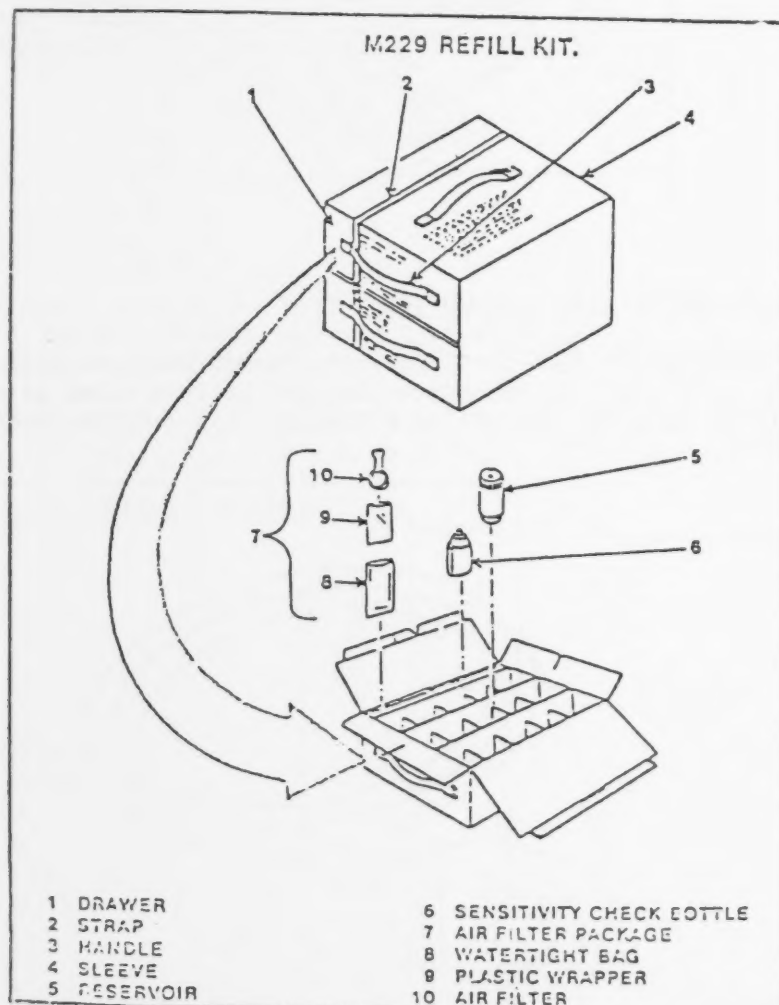
Battery, BA3517/U

The BA3517/U, 36-volt battery supplies primary power to the M43 Detector Unit when the alarm system is hand-carried or backpacked. The BA3517/U is a non-rechargeable battery with a variable battery life depending on air temperature. When the alarm system uses an M10 Power Supply as a primary DC power source, the BA3517/U battery is connected as a standby power source. The BA3517/U battery has a plastic case, a metal strap (1), a clamping catch (3), an identification plate (2), and a cable assembly (4).



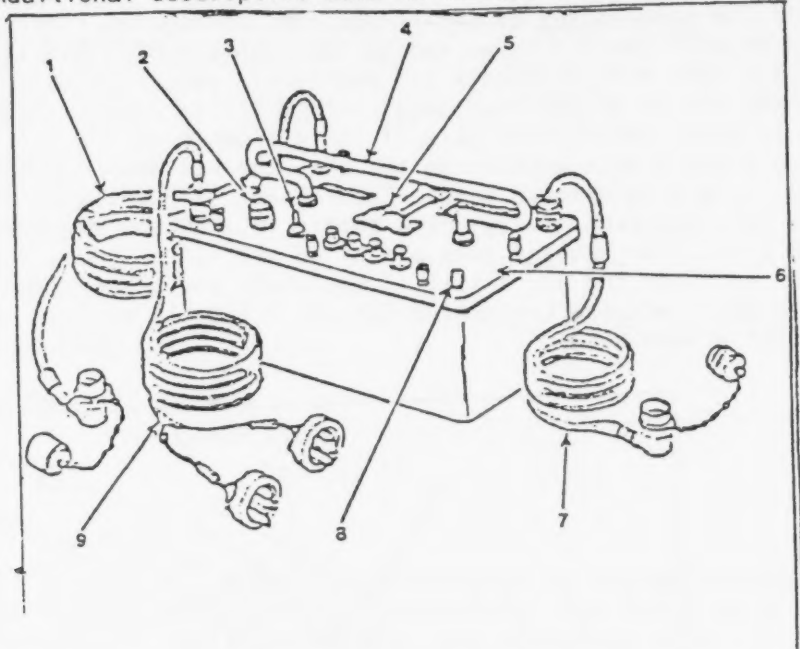
M229 Refill Kit

The M229 Refill Kit contains materials for 15 days of continuous operation. The kit consists of a sleeve (4), two drawers (1), and a plastic strap (2) that is discarded when the refill kit is first opened. The sleeve (4) and the drawers (1) are constructed of water-resistant corrugated fiberboard. The expiration date of the kit is marked on the sleeve. M229 Refill Kits produced after January 1983 will eliminate all shelf-life requirements. This change has been made due to an improved paper in the filter paddle. Users are cautioned to honor the discard date if it is stamped on the outside of the box. If no discard date appears on the box, the kit does not have a shelf life and will have no discard date. Each drawer (1) contains 15 solution reservoirs (5), one sensitivity check bottle (6), and 30 air filter packages (7). Each air filter package consists of an air filter (10), a plastic wrapper (9) in which the air filter is enclosed, and a watertight bag (8) in which the plastic wrapper containing the air filter is sealed. Each drawer is provided with a handle (3)



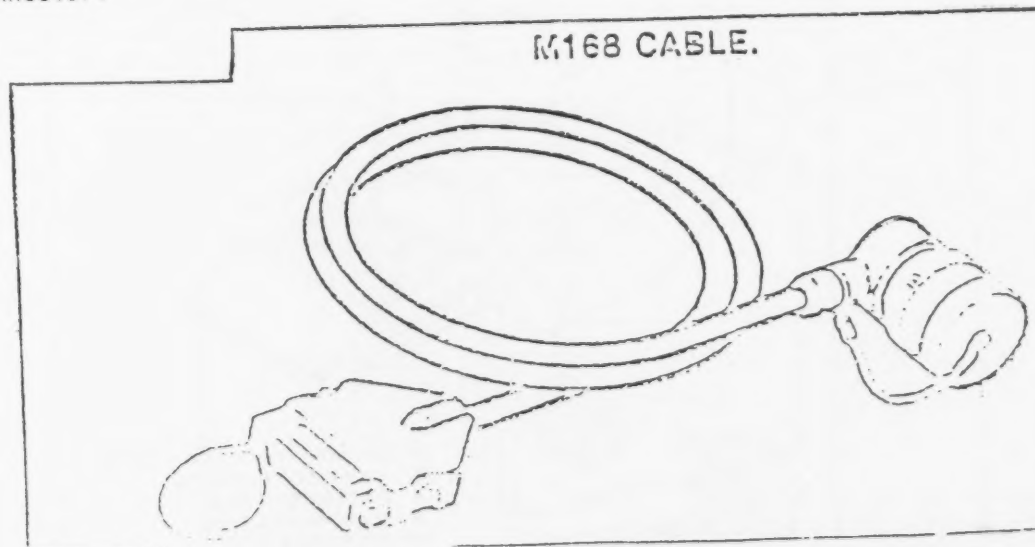
M10 Power Supply

The M10 Power Supply requires input power of 115 or 220 volts at 50, 60, or 400 hertz (found at fixed installations), and produces an average output of 29.5 volts DC. Additional descriptive data on the M10 Power Supply is in TM 3-6665-261-14



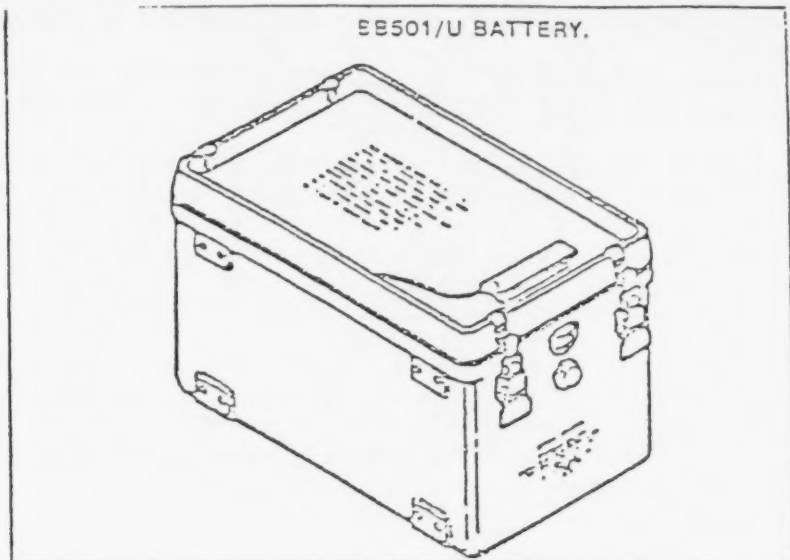
M168 Cable, Assembly, Power, Electrical

M168 Cable connects the BB501/U battery to the M43 Detector Unit or the M10 Power Supply. The cable is 50 inches long and is terminated at one end with an SCL-6028/4-3 connector and at the other end with a PT05A-14-5P or KPT47024-311 connector.



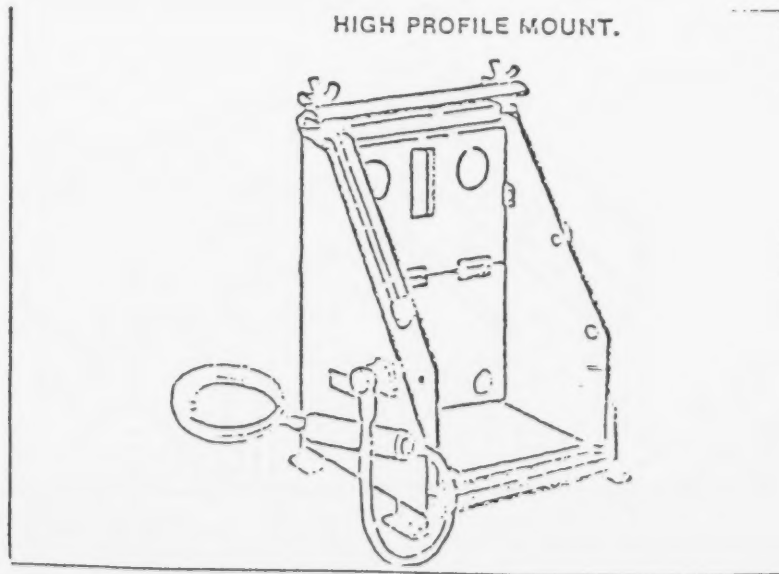
Battery, Storage, BB501/U

The BB501/U battery is a rechargeable, heavy-duty, nickel-cadium battery issued as a component of the winterization kit.

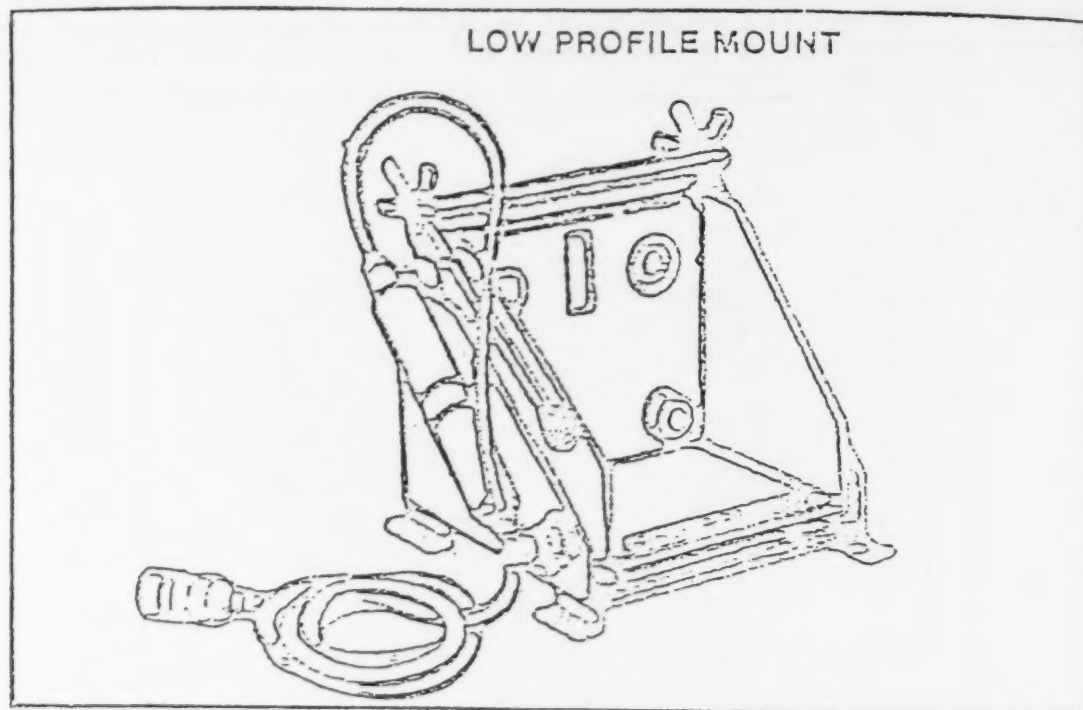


High-profile Mount

The high-profile mount part of the M228 Mounting Kit, is used to electrically connect and mount the M43 Detector Unit to a wheeled vehicle. The high-profile mount secures the M43 Detector Unit and the BA3517/U battery to a front fender of the vehicle. The high-profile mount consists of an electrical cable assembly and an inner wrap assembly that is shock mounted to an outer wrap assembly by six resilient mounts. TM 3-6665-273-20 describes the M228 Mounting kit.

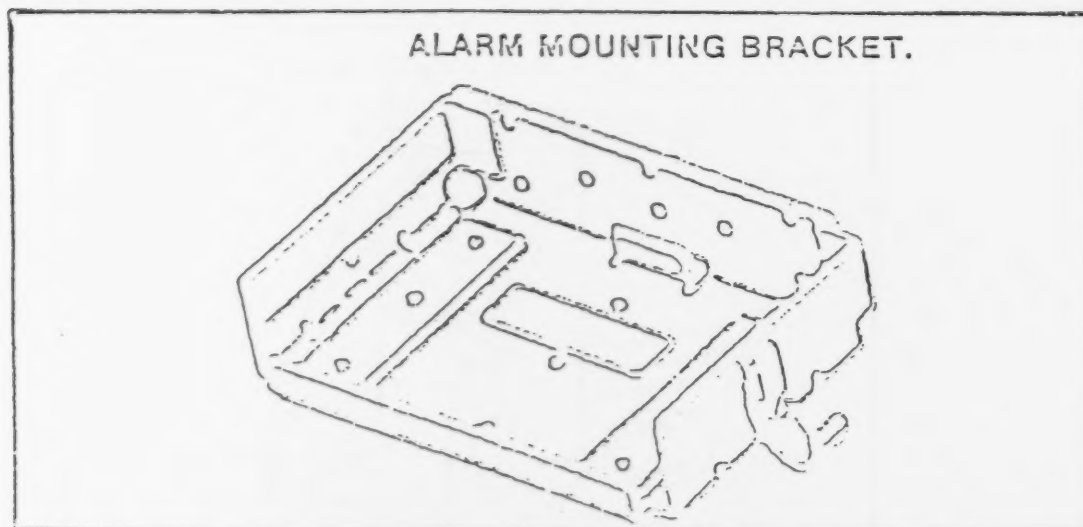


Low-profile Mount



Alarm Unit Mounting Bracket

The alarm unit mounting bracket, a component of the M182 and M228 installation kits, is used to electrically connect and mount the alarm unit to a wheeled or tracked vehicle.



Troop-installed Kits

Each installation kit mechanically and electrically adapts a specific vehicle to accept an M43 Detector Unit, an M42 Alarm Unit, an M228 or M182 mounting kit, and in some cases, refill kit components and a BA3517/U battery. TM 3-6665-273-20 and TM 3-6665-274-20 describe the installation kits.

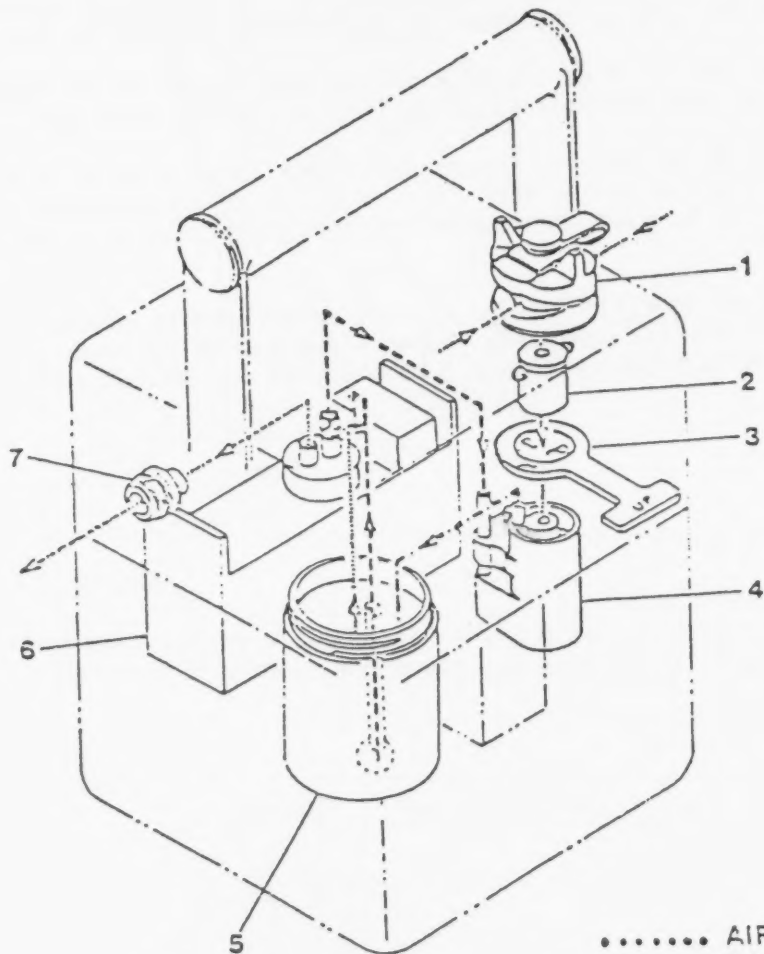
In addition to the equipment supplied as part of the alarm system, additional items are authorized to the operator to complete the system configuration.

Rucksack and Shelf. When the M8 Alarm System is used in the backpack configuration, the operator is authorized a rucksack with shelf.

Communication Wire (WD-1). The operator must acquire two pieces of WD-1 to connect the M42 Alarm Unit when installing the M8 Alarm System. Telephone cable must also be used when connecting additional M42 Alarm Units to the alarm system.

M253 Winterization Kit. The operator is authorized to requisition an M253 Winterization Kit for operating the M8 Alarm System in temperatures below +20°F. The M253 Winterization Kit consists of two BB501/U batteries and one M168 Cable.

M43 DETECTOR UNIT AIR-SOLUTION FLOW DIAGRAM.



..... AIR
- - - - - SOLUTION
- . - . - AIR-SOLUTION
 MIXTURE

- 1 AIR INLET
- 2 HEATER
- 3 AIR FILTER
- 4 DETECTOR CELL

- 5 RESERVOIR
- 6 PUMP ASSEMBLY
- 7 HEATER

Functional Description. Air is drawn into the M43 Detector Unit through the AIR INLET (1) and passes through a temperature-controlled heater (2). The heater (2) ensures that the temperature of the air sample, applied to the air filter (3), is not below 90°F. The air filter (3) removes foreign particles before the sample is processed in the detector cell (4). Solution is pumped from the reservoir (5) into the detector cell (4) by the pump assembly (6). The air sample combines with the solution within the detector cell (4). An electrical signal produced by the cell is monitored by the electronic module of the M43 Detector Unit. The air-solution mix is pumped out of the detector cell (4) back into the reservoir (5), where the air and solution separate. Next, the pump assembly (6) draws the air from the reservoir (5) and exhausts it through the AIR OUTLET heater (7) into the atmosphere. The AIR OUTLET heater automatically heats the AIR OUTLET to prevent icing. Solution drawn from the reservoir (5) is scrubbed of impurities in the detector cell (4) as it is recirculated by the pump assembly (6). When the air sample containing chemical agent is mixed with solution, the detector cell electrical output increases, and the electronic module turns on the horn and turns off the pump assembly. The horn will sound until the operator either resets the M43 Detector Unit or disconnects the power source. When the horn sounds, the electronic module also provides a trigger signal to the REMOTE binding posts so that the M42 Alarm Unit also provides a warning signal.

To put the Automatic Chemical Agent Alarm System into operation, you must first understand:

- Uses and components of the M8 Chemical Agent Alarm
- Preoperational procedures
- Pre-start-up procedures

A 1982 reclassification action resulted in the elimination of the M10 through M18 chemical agent alarm configurations. The one and only remaining alarm is the M8 configuration, NSN 6665-00-935-6955, LIN A32060.

Preoperational Procedures

These procedures prescribe mandatory equipment inspections prior to preparing the equipment for operation under usual environmental conditions. Usual environmental conditions are defined as ambient (surrounding) air temperature above 49°F, no precipitation, and no apparent presence of blowing dust or sand.

NOTE

Inspect the exterior of the M43 Detector Unit for cracks or breaks, and loose or missing parts. Turn in units suspected of damage or inability to operate properly because of visible deficiencies.

M43 Detector Unit. When an M43 Detector Unit is received as new equipment, or taken out of long-term storage, the following inspection checks should be conducted:

Step 1. Check that RAINSHIELD assembly and FLOWMETER are not damaged, and are installed in the handle.

Step 2. Release four clamping catches, and remove the detector unit assembly from the bottom case assembly. Place the detector unit assembly on its side with the AIR FILTER plug up.

Step 3. Check that the bottom case assembly contacts, and that the meeting contact on the detector unit assembly is not corroded, broken, or bent.

Step 4. Check that the detector cell is securely installed.

Step 5. For new equipment, install the detector cell as follows:

- a. Remove the strap from the bail.
- b. Remove the detector cell can from the handle.
- c. Remove the detector cell from the can.
- d. Remove the plastic bag, the two caps, and the plug.
- e. Dampen the outside of the two detector cell ports with a few drops of water.
- f. Position the detector cell so that its ports are aligned with their corresponding fittings in the chassis. Press the detector cell into place in the chassis.

g. Center the bail on the bottom of the detector cell, and turn the lobed nut clockwise until it is fingertight.

Step 6. Verify that the catches of pump assembly are secured.

Step 7. Check that the turnlock fastener of the electronic module is locked in position.

Step 8. Install the detector unit assembly in the bottom case assembly and secure the four clamping catches.

M42 Alarm Unit. When an M42 Alarm Unit is received as new equipment, or taken out of long-term storage, the following inspection checks should be conducted:

Step 1. Install batteries

NOTE

Notify personnel within audible range that a test of the M42 Alarm Unit is to be made.

Step 2. Position the selector switch to TEST. If the M42 Alarm is operative, a loudspeaker will sound, and the ALARM-RED indicator will flash.

Step 3. If the M42 Alarm Unit does not operate in TEST mode, install fresh batteries. Repeat #1 above.

Step 4. Position the selector switch to HORN OFF.

M229 Refill Kit. When an M229 Refill Kit is received as new equipment, or taken out of long-term storage, the following inspection checks should be conducted:

Step 1. Check the date on the M229 Refill Kit sleeve. Discard any M229 Refill Kit with an expired date or mark "For Training Only" on the sleeve. Newer issues of the M229 Refill Kit do not have a discard date. These kits are good until all components are used.

Step 2. Check that each reservoir assembly is filled above the line on each container. Check that the liquid in the reservoir assembly is clear, not discolored or contaminated. Discard defective reservoir assemblies in the M229 Refill Kit. Check that the sensitivity check bottle contains enough liquid for the mission.

Step 3. Check the contents of the M229 Refill Kit to assure that enough reservoir assemblies and air filters are available for the mission.

BA3517/U Battery. Inspect the BA3517/U battery for bent or broken connector pins that could prevent a proper electrical connection, and also check for frayed or broken cable assembly insulation. Inspect the case for damage, such as cracks, that could prevent proper use of the battery. Replace any BA3517/U battery that is suspected of being damaged.

If the following items are included in the system configuration, preoperational checks should be performed on them.

M10 Power Supply. When an M10 Power Supply is received as new equipment, or taken out of long-term storage, the following inspection checks should be conducted:

Step 1. Unbuckle the strap, unwind the STANDBY BATTERY cable, the DETECTOR POWER cable, and the 115V/220B cable from the handle.

Step 2. Connect the 115V/220V cable to a power source.

Step 3. Set the power switch to either the 115V or 220V position; this is determined by the input voltage to which the M10 power supply is connected. The POWER ON indicator must light.

Step 4. Set the annunciator to its "all white" position by turning it fully clockwise. Then, rotate the annunciator fully counterclockwise.

Step 5. Position the power switch to OFF.

Step 6. Disconnect the 115V/220V cable from its power source.

BB501/U Battery and M168 Cable. Inspect and service the BB501/U battery in accordance with TM 11-6140-203-15-3. Inspect the M168 cable for bent or broken connector pins, frayed or broken cable assembly insulation, and other damage that could prevent a proper electrical connection and use of the battery. Replace the discharged or defective BB501/U battery with a freshly charged battery, and replace the M168 cable assembly if suspected of being damaged.

Mounting Kit. If a mounting kit is part of the system configuration, check that the vehicular mounting components are secure. Check the cables for damage (cuts, chafed insulation, exposed wires) and secure the connections. Return vehicles to organizational maintenance that have loose-mounting kit components and cables that are suspected of damage.

Pre-Start-Up Procedures

These procedures prescribe the method of preparing and installing the solution reservoir assembly and installing the air filter in the M43 Detector Unit.

CAUTION

Before airdrop operations, empty the liquid from the M43 Detector Unit reservoir assembly. Internally splashing liquid may cause the M43 Detector Unit to become inoperative and cause the mission to be aborted. Do not perform the following procedures until after the airdrop:

Step 1. Remove one solution reservoir assembly from the drawer of the M229 Refill Kit.

Step 2. Prepare the solution.

Step 3. Install the reservoir assembly.

a. Release the four clamping catches from the bottom catches, and remove the detector unit assembly from the bottom case assembly.

CAUTION

Keep the weight assembly free from dirt after removing the reservoir assembly.

b. Hold the detector unit assembly upright by its handle, and unscrew the reservoir assembly counterclockwise. Allow the weight assembly to hang down. Discard the used reservoir assembly in accordance with standing operating procedures.

c. Remove and discard the cap from the prepared solution reservoir assembly.

d. Center the new reservoir assembly under the weight assembly, and screw the reservoir assembly clockwise into the mounting hole in the detector assembly. Ensure a tight seal by turning the reservoir D ring clockwise.

NOTE

If the M43 Detector Unit is to be backpacked, position the bottom case assembly so that the instruction plate is on the side opposite the 24 VDC INPUT receptacle.

e. Check that the seal is completely seated in the groove around the top of the bottom case assembly. Assembly the detector unit assembly to the bottom case assembly and secure the clamping catches.

Step 4. Install the air filter.

NOTE

If the air filter has been installed in the M43 Detector Unit for less than 24 hours, it may be used during the reservicing procedures. Remove one additional air filter package to be used during the start-up procedures.

- a. If the air filter has been in the M43 Detector Unit for 24 hours or more, or if no air filter is in place, remove the two air filter packages from the M229 Refill Kit. Also remove the sensitivity check bottle.

NOTE

One air filter will be used during start-up and one will be used during the mission.

- b. Unscrew the AIR FILTER plug. Remove and discard the air filter from the M43 Detector Unit.
- c. Open and discard the watertight bag. Remove the air filter from the plastic wrapper and discard the plastic wrapper.
- d. Insert the air filter into the AIR FILTER slot of the M43 Detector Unit with the black side of the filter material facing up
- e. Install and tighten the AIR FILTER plug.

Perform Start-up and Operational Procedures for the Automatic Chemical Agent Alarm System

These procedures start and place the alarm system into operation:

Step 1. Remove the AIR OUTLET cap from the AIR OUTLET port. Remove the cover from the 24 VDC INPUT connector.

Step 2. Check that the AIR INLET ASSEMBLY IS IN THE CLOSED position. Unscrew the plug.

Step 3. Press the ZERO ADJUST knob, rotate it fully clockwise, and release it

NOTE

Notify personnel within audible range that the alarm system is to be tested.

If any start-up test fails, refer to the operator's troubleshooting information.

Step 4. If the M42 Alarm Unit is not connected to the M43 Detector Unit, it should be connected at this time. The M43 Alarm Unit is connected by attaching the wires at one end of a piece of communications wire (WD-1) to the binding posts on the M42 Alarm Unit, and the wires from the other end of the WD-1 to the binding posts on the M43 Detector Unit.

Step 5. Connect the power source connector to the 24 VDC INPUT connector of the M43 Detector Unit. The M43 Detector Unit horn and the M42 Alarm Unit loudspeaker must sound.

Step 6. Position the M42 Alarm Unit selector switch to HORN OFF, or disconnect one wire from the M43 Detector Unit HORN VOL-BATTERY TEST knob for the desired level.

Step 7. Press the ZERO ADJUST knob, rotate it fully counterclockwise, and release it. The horn must stop sounding and the pump assembly must operate.

Step 8. Press the HORN VOL-BATTERY TEST knob. The meter must indicate 24-volt minimum; release the knob.

Step 9. Remove the FLOWMETER from the handle. Install the rainshield adapter in the AIR INLET and the FLOWMETER on the adapter.

Step 10. Press down on top of the FLOWMETER. The ball must rise and float within the correct zone for ambient (surrounding) temperature.

Step 11. Press and hold the ZERO ADJUST knob in. Press in the hand crank, rotate the crank clockwise 50 turns, and release it.

NOTE

Keep the hand crank in the down position, not pressed in.

Step 12. Press and rotate the ZERO ADJUST knob until the meter indicates in the ZERO ADJUST zone (blue). Release the knob. After 5 minutes, press and reset, if necessary.

NOTE

If a new detector cell was installed, the M43 Detector Unit must be allowed to operate for 1 hour to stabilize the detector cell before proceeding.

Step 13. Disconnect the power source from the 24 VDC INPUT connector of the M43 Detector Unit. Position the M42 Alarm Unit selector switch to HORN ON, or connect the wire to the M43 Detector Unit REMOTE binding post.

Step 14. Remove the protective cap from the sensitivity check bottle. Unscrew the AIR FILTER plug and remove the air filter.

Step 15. Invert the sensitivity check bottle, and while holding the dropper tip 1/2-inch over the center of the black side of the filter material, allow two drops of the solution to fall on the filter.

Step 16. Immediately replace the air filter in the M43 Detector Unit and secure the AIR FILTER plug. Replace the cap on the sensitivity check bottle and return it to the M229 Refill Kit.

Step 17. Connect the power source to the 24 VDC INPUT connector of the M43 Detector Unit.

Step 18. Immediately press and hold the ZERO ADJUST knob for 5 seconds and release it. Within 15 seconds to 5 minutes, the M43 Detector Unit horn must sound, the M42 Alarm Unit loudspeaker must sound, and the ALARM-RED indicator must flash.

NOTE

If the M43 Detector Unit horn does NOT sound, repeat the above procedures starting with the application of the sensitivity test solution--twice, if necessary. Use a new filter each time. Then refer to the operator's trouble-shooting information.

Step 19. Disconnect the power source connector from the M43 Detector Unit 24 VDC INPUT connector.

Step 20. Remove the AIR FILTER plug and discard the used air filter. Open the unused air filter package; discard the watertight bag. Remove the air filter from the plastic wrapper and discard the plastic wrapper.

Step 21. Insert the air filter into the AIR FILTER slot of the M43 Detector Unit with the black side of the filter material facing upward. Install and tighten the AIR FILTER plug.

Step 22. Connect the power source to the 24 VDC INPUT connector.

Step 23. Press and adjust the ZERO ADJUST knob so that the meter indication is within the blue ZERO ADJUST zone. Then release the knob. Repeat after 5 minutes.

Step 24. Twist the FLOWMETER and the rainshield adapter clockwise, and remove them from the AIR INLET assembly cover. Install the FLOWMETER and the rainshield adapter in the M43 Detector Unit handle.

Step 25. Rotate the AIR INLET assembly to the OPEN position.

CAUTION

To prevent damage by overheating, never operate the M43 Detector Unit when the AIR INLET assembly is in the CLOSED position and the AIR INLET plug is installed.

Step 26. Install and secure the AIR INLET plug.

NOTE

The alarm system is now operational. When in operation, keep the M43 generally in an upright position. Tilting at angles greater than 45° may cause improper operation.

Perform 12-Hour Reservice and Reactivate the System After Alert

When the system is in continuous use, it must be reserviced periodically. It must also be reactivated after an operational alert.

12-Hour Reservice

The procedures for reservice of the system are described in the succeeding paragraphs. The procedure begins with checking the power source.

Power Source Checks. Dependent on the power source used to supply power to the M43 Detector Unit, the following checks will be accomplished:

M10 Power Supply. If the M10 Power Supply and the standby battery are in use, perform the following voltage level checks:

Step 1. Check the voltage output of the M10 Power Supply by pressing the M43 Detector Unit HORN VOL-BATTERY TEST knob. The meter must indicate the 24-volt minimum. Position the M10 Power Supply power switch to OFF.

Step 2. Check the voltage output of the standby battery by pressing the M43 Detector Unit HORN VOL-BATTERY TEST knob. The meter must indicate a minimum of 24-volts. Replace the discharged battery. Return the discharged BB501/U battery to organizational maintenance for recharging. Discard the discharged BA3517/U battery.

BA3517/U or BB501/U Batteries. If a BA3517/U battery or BB501/U battery is used as a primary power source, or the alarm system is installed in the vehicle, check the power source voltage output. Replace a battery which is discharged to the point where the voltage output is less than 24-volts. Return the discharged BB501/U battery to organizational maintenance for recharging. Discard a discharged BA3517/U battery.

M43 Detector Unit. At the end of a period of 12 hours of continuous operation, the M43 Detector Unit must be reserviced as follows:

- Step 1. Disconnect the power source from the 24 VDC INPUT connector.
- Step 2. Remove one solution reservoir assembly from the drawer of the M229 Refill Kit.
- Step 3. Prepare the solution.
- Step 4. Install the reservoir assembly.
- Step 5. Rotate the AIR INLET assembly to the CLOSED position. Unscrew the lug.
- Step 6. Press the ZERO ADJUST knob, rotate it fully clockwise, and release it.

NOTE

Notify personnel within audible range that the alarm system is to be tested.

Step 7. Connect the power source connector 24 VDC INPUT connector of the M43 Detector Unit. The M43 Detector Unit horn and the M42 Alarm Unit loudspeaker must sound.

Step 8. Position the M42 Alarm Unit selector switch to the HORN OFF, or disconnect one wire from the M43 Detector Unit REMOTE binding post. Adjust the HORN VOL-BATTERY TEST knob for the desired level.

Step 9. Press the ZERO ADJUST knob, rotate it fully counterclockwise, and release it. The horn must stop sounding, and the pump must operate.

Step 10. Press the HORN VOL-BATTERY TEST knob. The meter must indicate 24-volt minimum. Release the knob.

Step 11. Remove the FLOWMETER from the handle. Insert and twist the FLOWMETER firmly clockwise into the top of the AIR INLET assembly cover. Press down on the top of the FLOWMETER. The ball must rise and float within the correct zone for ambient temperature.

Step 12. Press and hold the ZERO ADJUST knob in. Press in the hand crank, rotate the crank clockwise 50 turns, and release it.

NOTE

Keep the hand crank in the down position, not pressed in.

Step 13. Press and rotate the ZERO ADJUST knob until the meter indicates in the ZERO ADJUST zone (blue). Release knob. After 5 minutes, press and reset, if necessary.

Step 14. Disconnect the power source connector from the M43 Detector Unit 24 VDC INPUT connector.

Step 15. Remove the protective cap from the sensitivity check bottle. Unscrew the AIR FILTER plug and remove the air filter.

Step 16. Invert the sensitivity check bottle and, while holding the dropper tip 1/2-inch over the center of the black side of the filter material, allow two drops of the solution to fall on the filter.

Step 17. Immediately replace the air filter in the M43 Detector Unit and secured the AIR FILTER plug. Replace the cap on the sensitivity check bottle.

Step 18. Connect the power source to the 24 VDC INPUT connector of the M43 Detector Unit.

Step 19. Immediately press and hold the ZERO ADJUST knob for 5 seconds and release it. Within 15 second to 5 minutes, the M43 Detector Unit horn must sound.

NOTE

If the M43 Detector Unit horn does NOT sound, repeat Steps 13 through 19--twice, if necessary. Use a new filter each time. Then refer to the operator's trouble-shooting information.

Step 20. Disconnect the power source connector from the M43 Detector Unit 24 VDC INPUT connector.

Step 21. Remove the AIR FILTER plug and discard the used air filter. Open the unused air filter package, and discard the watertight bag. Remove the air filter from the plastic wrapper and discard the plastic wrapper.

Step 22. Insert the air filter into the AIR FILTER slot of the M43 Detector Unit with the black side of the filter material upward. Install and tighten the AIR FILTER plug.

Step 23. Position the M42 Alarm Unit selector switch to HORN ON, or connect the wire to the M43 Detector Unit REMOTE binding post.

Step 24. Connect the power source connector to the M43 Detector Unit 24 VDC INPUT connector.

Step 25. Press and adjust the ZERO ADJUST knob so that the meter indication is within the blue ZERO ADJUST zone. Then release the knob. Repeat after 5 minutes.

Step 26. Twist the FLOWMETER clockwise and remove it from the AIR INLET assembly cover. Install the FLOWMETER in the M43 Detector Unit handle.

Step 27. Rotate the AIR INLET assembly to the OPEN position.

CAUTION

To prevent damage by overheating, never operate the M43 Detector Unit when the AIR INLET assembly is in the CLOSED position and the AIR INLET plug is installed.

Step 28. Install and secure the AIR INLET plug. If the M43 Detector Unit is mounted on a vehicle, remove the RAINSHIELD assembly, and install and secure it in the air inlet assembly.

NOTE

The alarm system is not operational.

Reactivation of the Automatic Chemical Agent Alarm System

When placed into operation, the Automatic Chemical Agent Alarm will continuously sample the air from the area and, upon detection of a chemical agent, will signal an operational alert.

NOTE

The M43 Detector Unit will signal in the event of a nuclear explosion, or when exposed to heavy concentrations of rocket propellant smoke, screening smoke, signaling smoke, or engine exhaust.

When the alarm system signals the presence of chemical agents, perform the following steps:

Step 1. Immediately take the protective measures prescribed in FM 21-2.

Step 2. Give the local alert as prescribed by local standing operating procedures (SOP).

Step 3. Disconnect the power source from the M43 Detector Unit 24 VDC INPUT connector.

Step 4. Set the AIR INLET assembly cover to the CLOSED position. Remove the RAINSHIELD assembly from the cover, if used. Install the electrical connector

Step 9. Press and rotate the ZERO ADJUST knob until the meter indicates in the ZERO ADJUST zone (blue). Release the ZERO ADJUST knob. After 5 minutes, press and reset, if necessary.

Step 10. If the meter does not indicate in the ZERO ADJUST zone (blue), press and hold the ZERO ADJUST knob in. Press in the hand crank, rotate the crank clockwise 25 turns and release it. Press and rotate the ZERO ADJUST knob until the meter indicates in the ZERO ADJUST zone (blue). Release the ZERO ADJUST knob. After 5 minutes, press and reset, if necessary.

Step 11. Rotate the AIR INLET assembly to the OPEN position.

Step 12. Twist the FLOWMETER clockwise and remove it from the AIR INLET assembly cover. Install the FLOWMETER in the M43 Detector Unit handle. Install the plug in the cover, or if vehicle-mounted, install the RAINSHIELD assembly in the cover.

Shutdown Procedures

Shutdown for 72 Hours or Less. If alarm system is to be shutdown for 72 hours or less and reused within 72 hours, perform following procedures:

- a. If M10 power supply is in use, set 115V/OFF/220V power switch to OFF.
- b. Press HORN VOL-BATTERY TEST switch on M43 detector unit and note indication of meter. If meter indicates less than 24, discard BA3517/U battery or forward BB501/U battery to organizational maintenance for recharging.
- c. Disconnect power source from 24 VDC INPUT connector.
- d. Install electrical connect cover on 24 VDC INPUT connector.
- e. Press in M43 detector unit REMOTE binding posts, remove telephone cable connections, and release binding posts.
- f. Release four clamping catches from bottom catches. Remove the detector unit assembly from the bottom case assembly.
- g. Remove reservoir assembly. Discard solution in accordance with standing operating procedures. Install empty reservoir assembly to detector unit assembly.
- h. Ensure that seal is correctly seated in groove around the top of bottom case assembly; then fasten four clamping catches.
- i. Set AIR INLET assembly to CLOSED POSITION.
- j. Pull up hand crank to storage position.
- k. Install AIR OUTLET cap on AIR OUTLET port.

Shutdown For More Than 72 Hours. If alarm system is to be shutdown for more than 72 hours, return M43 detector unit and M42 alarm unit to organizational maintenance for administrative storage.

M43 Detector Unit

Before the M43 detector unit is shut down for more than 72 hours, it must be cleared of residual solution and inspected, the meter and handcrank must be protected from damage, and all ports must be closed.

Step 1. Disconnect power source from 24 VDC INPUT connector.

Step 2. Release four catches and remove detector unit assembly from bottom case assembly

CAUTION

Keep weight assembly free from dirt after removing reservoir assembly.

Step 3. Hold detector unit assembly upright by its handle, and unscrew reservoir assembly. Allow the weight assembly to hang down. If solution is in reservoir assembly, discard it in accordance with standing operating procedures.

CAUTION

Use only distilled water when preparing the detector unit assembly for shipment. Use of water which contains impurities will cause damage to the detector cell.

Step 4. Rinse reservoir assembly with distilled water and fill it approximately two-thirds with distilled water.

Step 5. Center reservoir assembly under weight assembly and screw reservoir assembly into mounted hold in chassis. Ensure a tight seal by turning reservoir assembly D-ring clockwise.

Step 6. Check that seal is correctly seated in groove around top of bottom case assembly. Assembly detector unit assembly to bottom case assembly and secure four catches.

Step 7. Remove AIR OUTLET CAP from port.

Step 8. Remove electrical connector cover from 24 VDC INPUT receptacle.

Step 9. Check that AIR INLET assembly is in CLOSED position. Unscrew plug.

Step 10. Attach power source connector to the 24 VDC INPU connector. If horn sounds, press ZERO ADJUST knob and rotate it fully counterclockwise.

Step 11. Press handcrank in, rotate the handcrank 50 turns, and release it. Do not pull the handcrank out.

Step 12. Allow M43 detector unit to run for 4 minutes. Then disconnect power source from the 24 VDC INPUT connector.

Step 13. Release four catches and remove detector unit assembly from bottom case assembly.

Step 14. Hold detector unit assembly upright by its handle and unscrew reservoir assembly.

Step 15. Discard contents of reservoir assembly and screw empty reservoir assembly into mounting hold in chassis.

Step 16. Install detector unit assembly in bottom case assembly and secure it with four catches.

Step 17. Install AIR OUTLET cap in AIR OUTLET port.

Step 18. Screw plug into AIR INLET assembly. Check that AIR INLET assembly is set to CLOSED.

Step 19. Install electrical connector cover on 24 VDC INPUT connector.

Step 20. Pull up handcrank to storage position.

Step 21. Release catch on BA3517/U battery, if applicable, and remove the battery.

M42 Alarm Unit

Step 1. Remove the batteries.

Step 2. Close hinged cover and secure it with spring-tension clip.

Step 3. With gasket in place, position chassis assembly in housing.

Step 4. Secure by tightening four knurled screws.

PLAN THE POSITIONING OF THE M8 ALARM

CONDITIONS

Given a situation where chemical agents have been used or are expected to be used, and the directive to plan for the positioning of the M8 Automatic Chemical Agent Alarm.

STANDARDS

Correctly answer 8 out of 10 multiple choice questions on the positioning of the M8 Automatic Chemical Agent Alarm.

PERFORMANCE MEASURES

1. Planned and supervised positioning the M8 alarm in a stationary setup.
2. Planned and supervised positioning the M8 alarm in a mobile setup.

REFERENCES:

FM 21-3, Task 031-503-4002.

TYPES OF SETUPS AND LIMITATIONS FOR THE AUTOMATIC CHEMICAL AGENT ALARM SYSTEM

The Automatic Chemical Agent Alarm is designed to be set up for employment in the following emplacement configurations:

- Handcarry and backpack system
- Fixed-emplacement installation
- Vehicle mounted

Handcarrying or Backpacking the M43 Detector Unit

The M43 Detector Unit, when operated in the handcarry or backpack configuration, uses a BA3517/U battery for a power source. The M43 Detector Unit and BA3517/U battery are secured to a rucksack with a cargo shelf. The M442 Alarm Unit supplied with the handcarry or backpack configuration permits the system to be used as a fixed-emplacement installation with one remote-located M42 Alarm Unit. The following instructions tell how to set the system up for backpacking.

- Perform applicable preoperation procedures and prestart-up procedures.
- Position the cargo shelf on the rucksack.

Pass the short web strap around the top and middle bars of the rucksack so that the strap is centered between the right and left sides of the rucksack. The buckle of the short web strap must be on the load side of the rucksack and not more than four inches from the middle bar. Insert the plain end of the short web strap through the buckle. Tighten the short web strap as tautly as possible.

- Tie one end of the long web strap to the right end of the middle bar of the rucksack using a nonslip knot.
- Tie one end of the other long web strap to the left end of the middle bar of the rucksack using a nonslip knot.
- Pass the free ends of the long web straps through the adjacent outer slots of the cargo shelf.

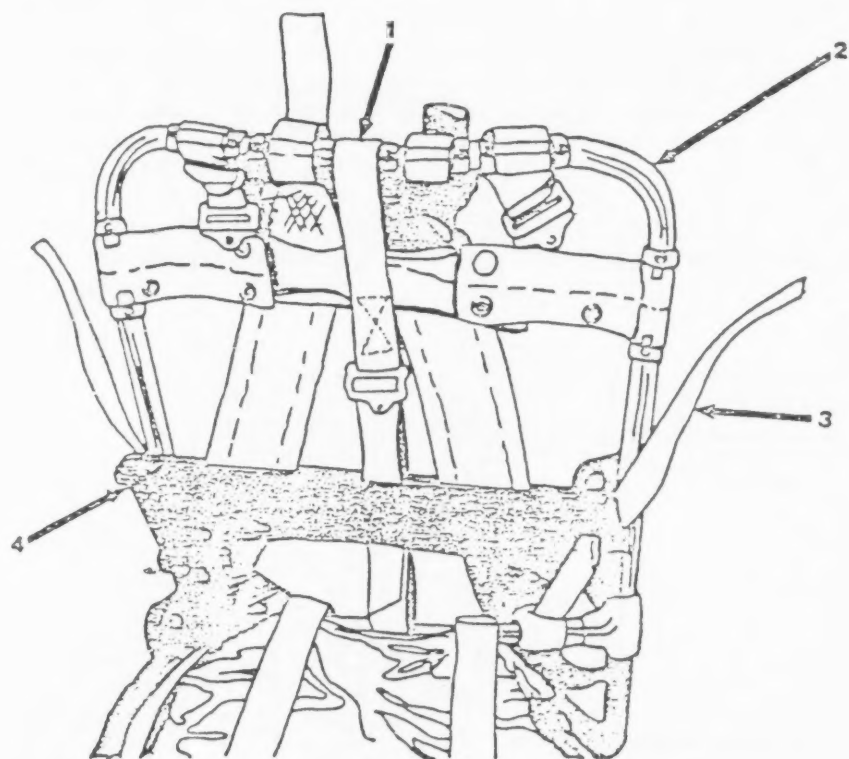
- Pull the cargo shelf into a horizontal position.

- Perform procedures for start-up of the alarm.

- Place the rucksack in an upright position.

- Position the M43 Detector Unit with attached BA3517/U battery on the cargo shelf so that the AIR FILTER plug is facing away from the frame of the rucksack.

PREPARING RUCKSACK FOR BACK-PACKING.



1 STRAP
2 RUCKSACK

3 STRAP
4 CARGO SHELF

CAUTION

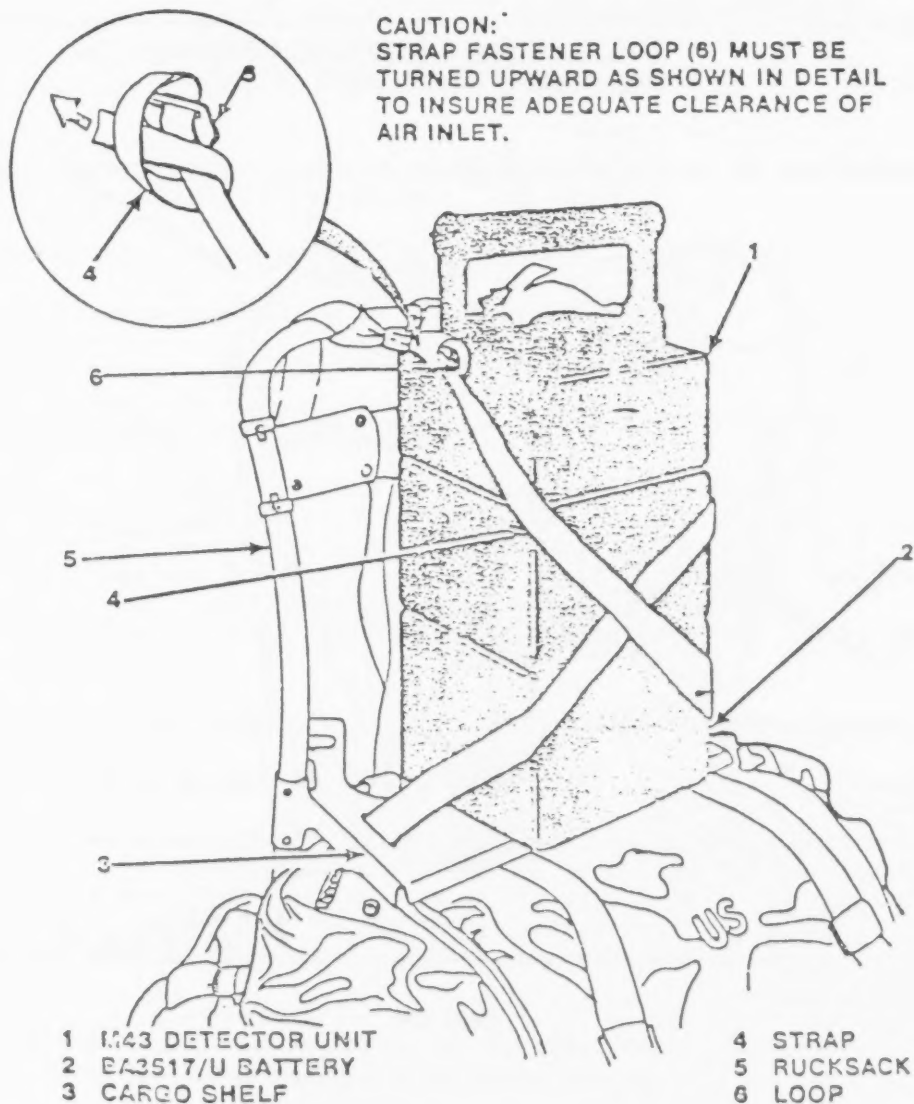
Do not block the AIR OUTLET.

- Tie the long web strap to the right end of the middle bar of the rucksack. Pass the strap across the M43 Detector Unit and attached battery. Turn the strap fastener loop upward on the left side of the M43 Detector Unit. Insert the long web strap through the loop. Pull it until tight.

- Pass the free end of the long web strap around the top bar, through the slot, and pull it tight. Tie the free end in an overhand knot while maintaining tension.

M43 DETECTOR UNIT AND BA3517/U BATTERY INSTALLED ON A RUCKSACK.

CAUTION:
STRAP FASTENER LOOP (6) MUST BE
TURNED UPWARD AS SHOWN IN DETAIL
TO INSURE ADEQUATE CLEARANCE OF
AIR INLET.



CAUTION

Do not block the AIR OUTLET.

- Pass the long web strap, which is tied to the left end of the middle bar of the rucksack, across the M43 Detector Unit and battery. Insert this long web strap through the strap fastener loop on the right side of the M43 Detector Unit. Keep the long web strap flat and pull it downward until tight. Then pass its free end around itself and pull it tight.

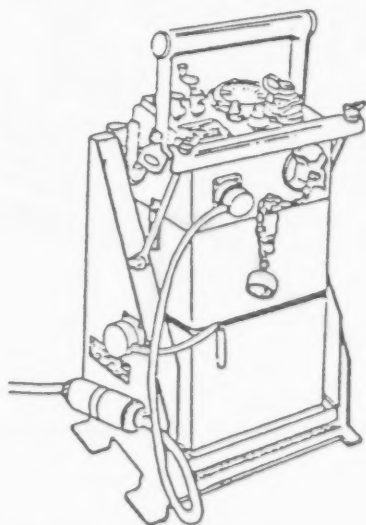
- Tighten the straps to insure that the M43 Detector Unit and BA3517/U battery are securely fastened to the rucksack.

Vehicle-mounted

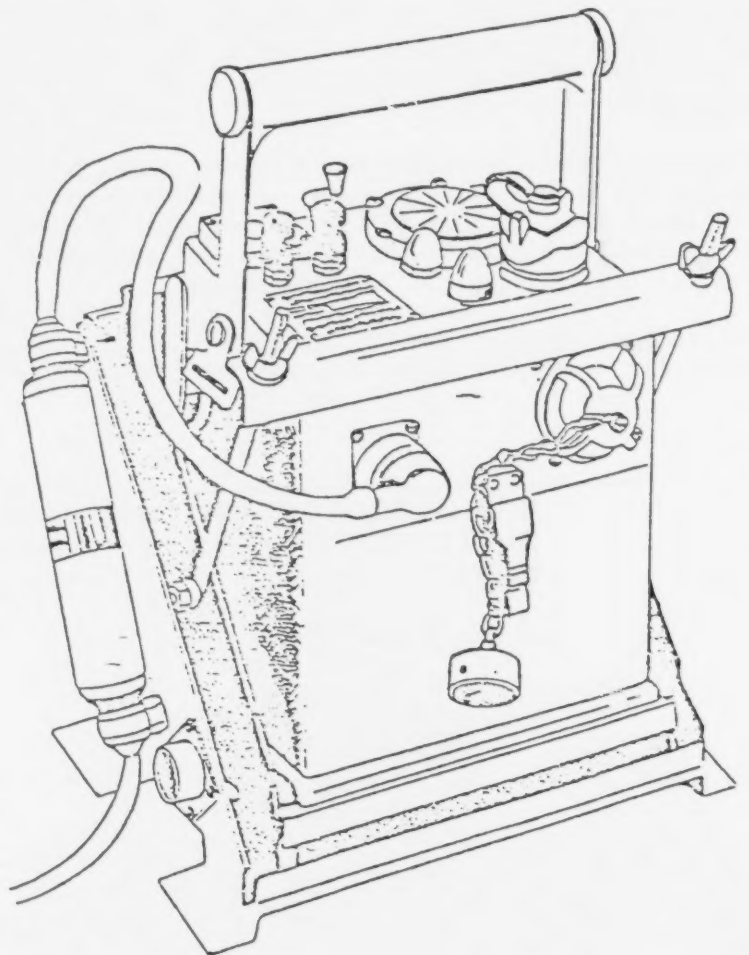
Vehicular Automatic Chemical Agent Alarm System installations provide accommodations for an M43 Detector Unit, an M42 Alarm Unit, and a BA3517/U battery. Primary power to operate the equipment is supplied by the vehicle electrical system. The BA3517/U battery provides power when the M43 Detector Unit is removed from the vehicle and handcarried.

When installed on a vehicle, the M43 Detector Unit is mounted in a high-profile mount for wheeled vehicles and in a low-profile mount for full-tracked vehicles.

**M43 DETECTOR UNIT AND BA3517/U
BATTERY INSTALLED IN HIGH-
PROFILE MOUNT.**

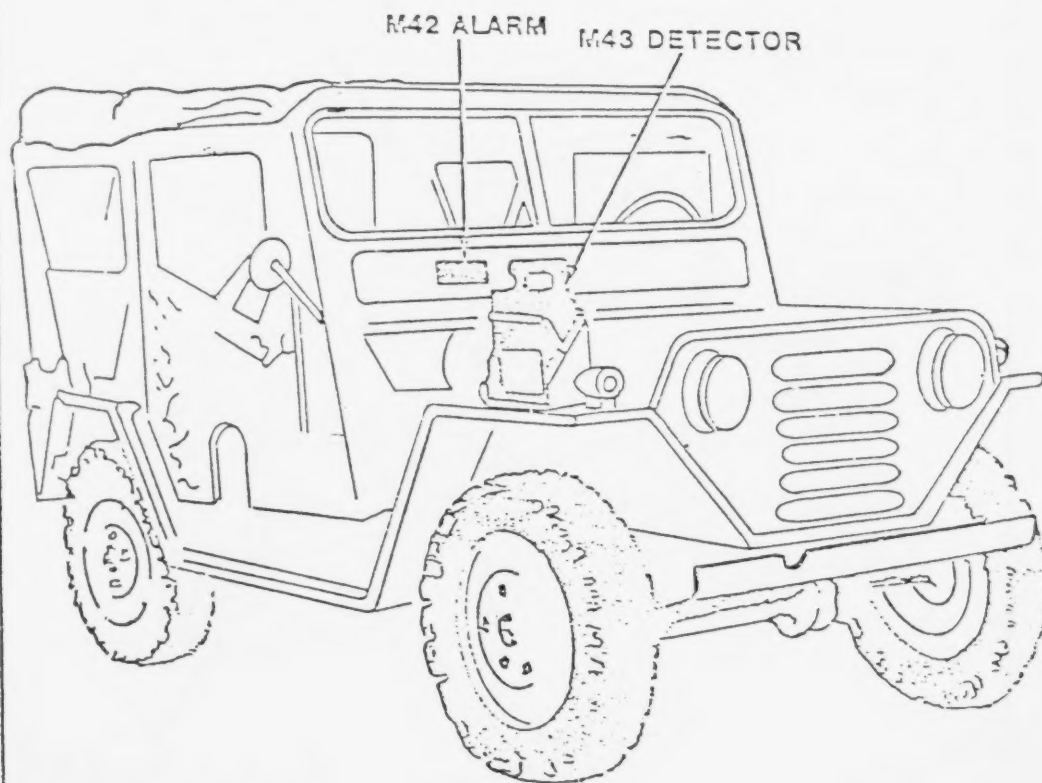


M43 DETECTOR UNIT INSTALLED IN
LOW-PROFILE MOUNT.

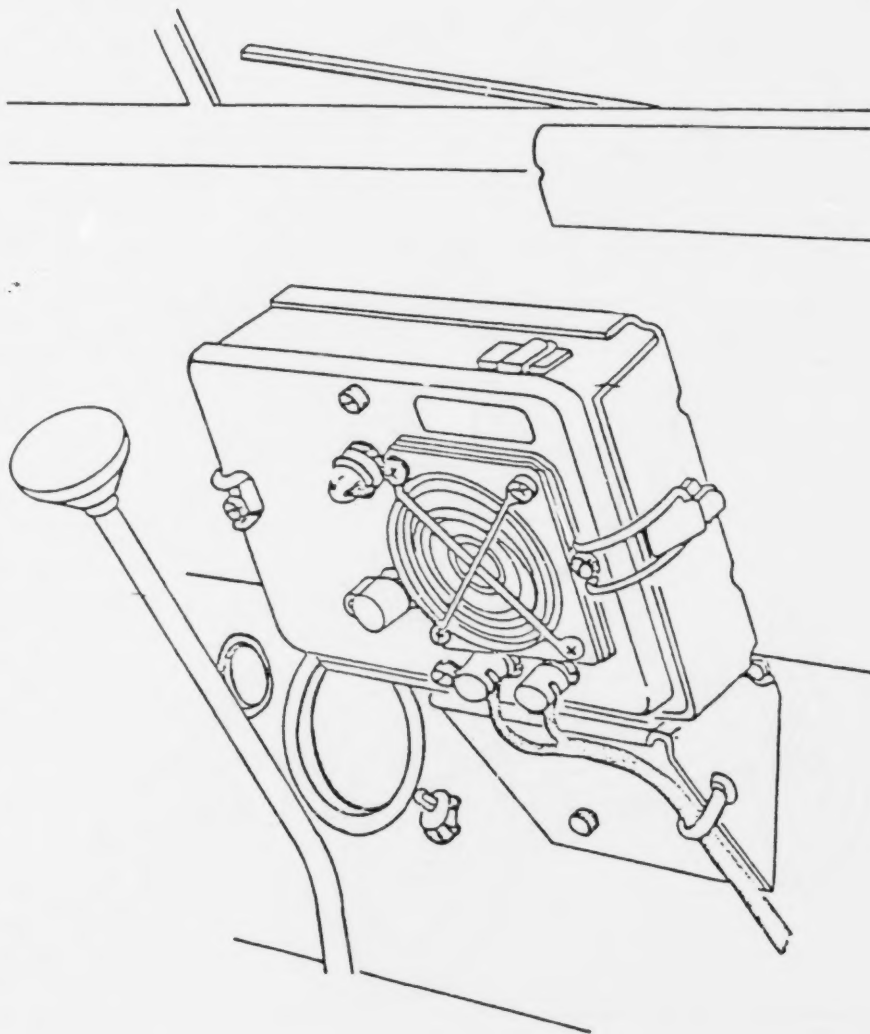


The alarm system can be installed on a one-quarter-ton utility truck. The M43 Detector Unit is installed and connected to a high-profile mount on the right-front fender of the vehicle. The M42 Alarm Unit is installed on the dash panel.

M42 ALARM UNIT INSTALLED IN A
ONE-QUARTER-TON UTILITY TRUCK.

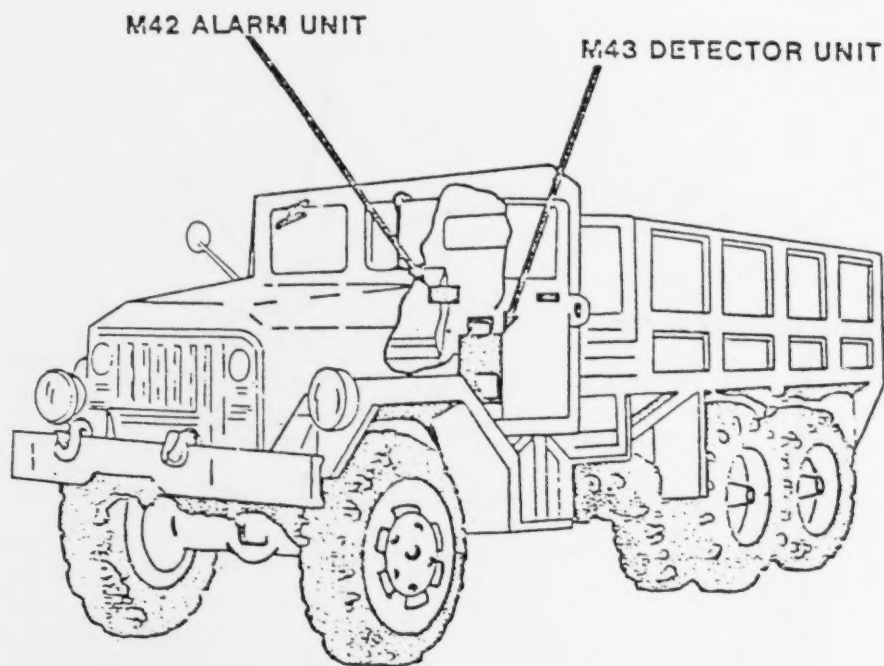


M8 ALARM SYSTEM INSTALLED IN A
ONE-QUARTER-TON UTILITY TRUCK.

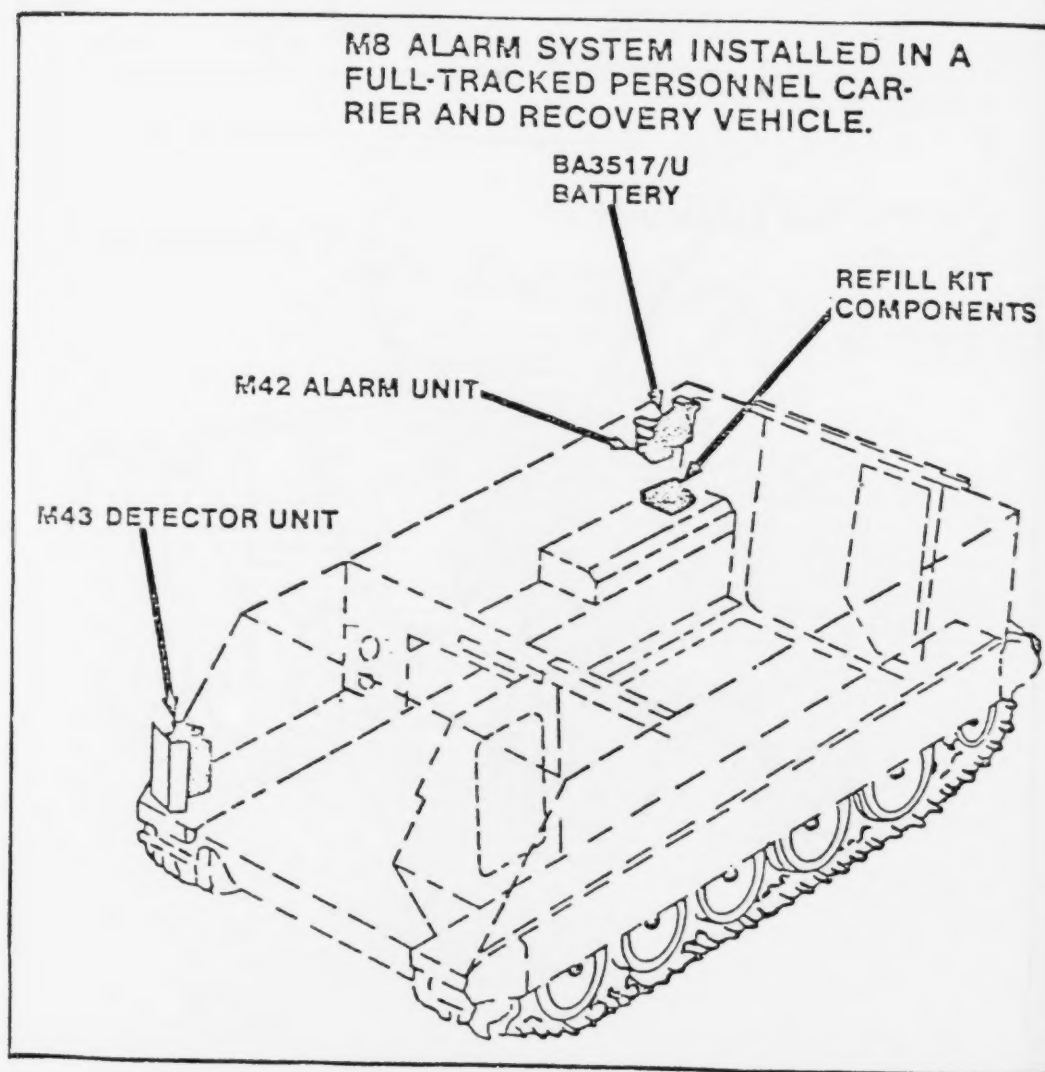


The alarm system can also be installed on a 2 1/2-ton-truck. The M43 Detector Unit is installed and connected to a high-profile mount on the rear of the left-front fender. The M42 Alarm Unit is installed on the cab wall behind the companion seat.

**M8 ALARM SYSTEM INSTALLED IN A
TWO-AND-ONE-HALF-TON UTILITY
TRUCK.**



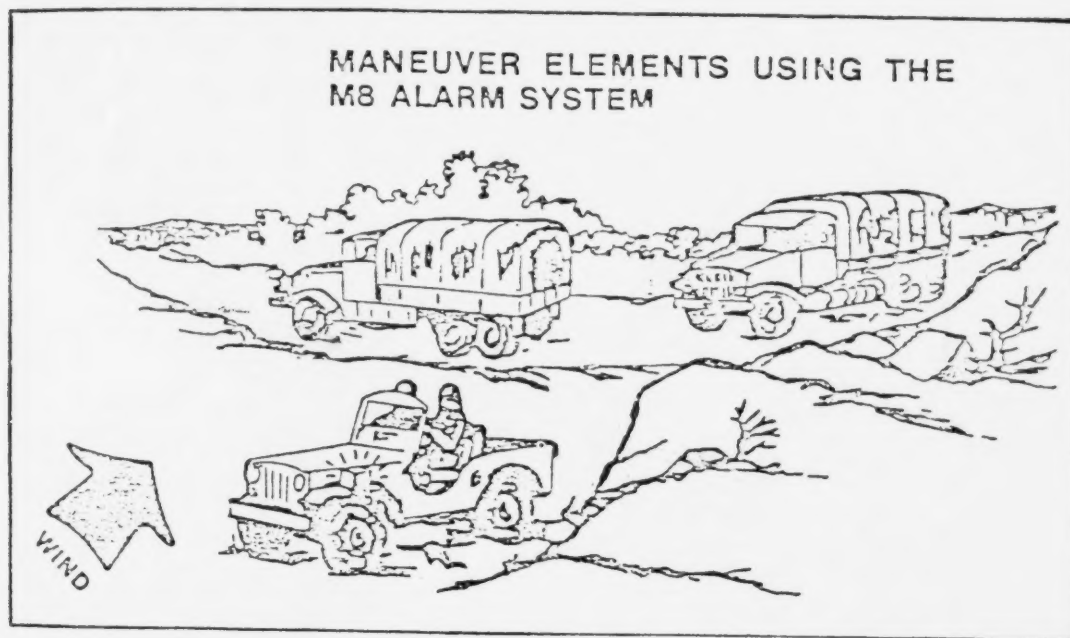
The diagram below shows the M8 Alarm System installed on a full-tracked personnel carrier and recovery vehicle. The M43 Detector Unit is installed and connected to a low-profile mount on the hull right-nose plate. The M42 Alarm Unit and BA3517/U battery are mounted on a common bracket secured to the right-rear corner of the hull-top plate. Refill kit components are secured to a bracket mounted on the battery box on the right sponson.



When the Automatic Chemical Agent Alarms are mounted on vehicles, consideration must be given to wind direction for the protection of the main body.

For maneuvering units, upwind security elements employ the Automatic Chemical Alarm System to provide early warning for the main body. Increased MOPP is required for security elements since they have no early-warning capability. However, reduced MOPP may be possible for the main body. The commander determines the MOPP based on the mission, threat, and heat-loading factors.

The single most important factor in employing the system is to make sure that the detector is upwind of the position or formation to be protected.

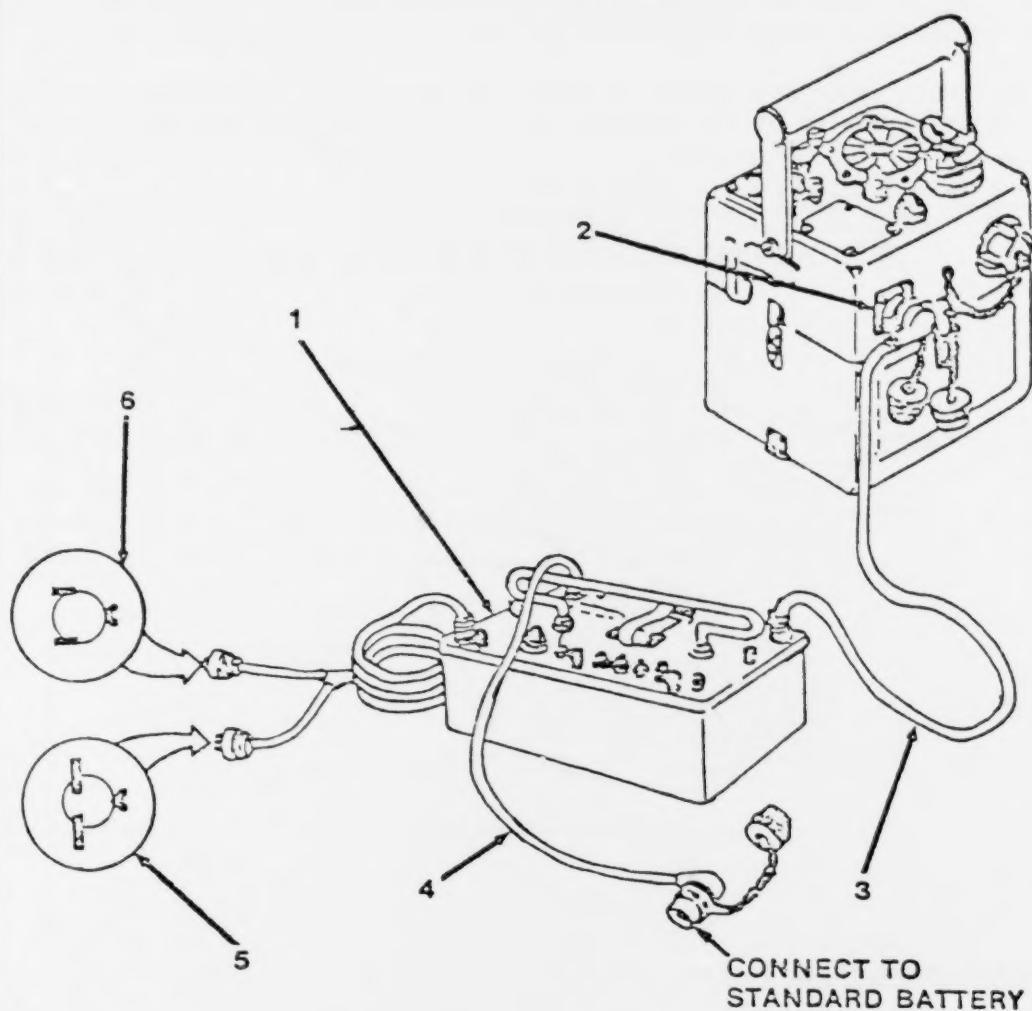


Fixed-emplacement Installation

The fixed-emplacement arrangement of the alarm system uses an M10 Power Supply as a power source. The M10 Power Supply requires an input voltage of 115 or 220 volts at a frequency of 50, 60, or 400 hertz. A standby battery (either the BA3517/U or the BB501/U employed with the M43 Detector Unit) is connected to the M10 Power Supply to automatically provide power to the M43 Detector Unit in the event of a power failure. If the M10 Power Supply output voltage decreases to less than 18 volts, a relay in the M10 Power Supply connects standby battery power to the M43 Detector Unit. The following instructions tell how to set the system up for fixed emplacement.

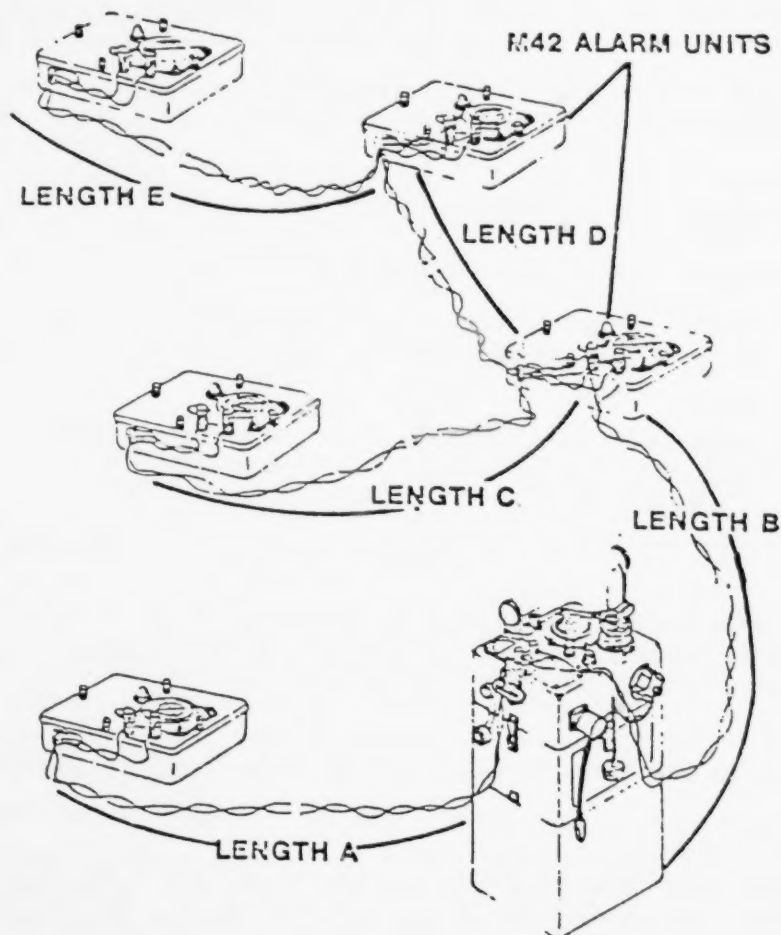
Be sure that applicable preoperation procedures and prestart-up procedures have been performed IAW the technical manual.

M43 DETECTOR UNIT EMPLOYING AN M10 POWER SUPPLY.



In a fixed-emplacement installation of the M8 Automatic Chemical Agent Alarm System, arrangements of one to five M42 Alarm Units may be connected in series to a single M43 Detector Unit.

M43 DETECTOR UNIT EMPLOYING M42 ALARM UNIT(S).



NOTES

1. LENGTH A MUST NOT EXCEED 400 METERS.
 2. LENGTH B + LENGTH C MUST NOT EXCEED 400 METERS.
 3. LENGTH B + LENGTH D + LENGTH E MUST NOT EXCEED 400 METERS.
- (400 METERS = 437.6 YARDS)

The distance of unit front to be protected corresponds to the number of detectors required for protection. Larger distances require more detectors. The number of detectors required to protect a unit front of a given area is tabulated below.

M43 DETECTOR UNITS REQUIRED TO PROTECT A UNIT FRONT.	
UNIT FRONT SIZE (METERS)	M43 DETECTOR UNITS REQUIRED
1 - 36	1
37 - 372	2
373 - 708	3
709 - 1044	4
1045 - 1380	5
1381 - 1716	6
1717 - 2052	7
2053 - 2388	8
2389 - 2724	9
2725 - 3060	10

NOTE

Up to five M42 Alarm Units can be connected in an Automatic Chemical Agent Alarm System. Do NOT connect more than one M43 Detector Unit in a system.

Communication Wire (WD-1) is used to connect the M42 Alarm Units to an M43 Detector Unit. The M42 Alarm Units are placed at or close to monitoring positions.

The M43 Detector Unit and its power source are placed up to 400 meters upwind of the alarm position. When more than one M42 Alarm Unit is connected to an M43 Detector Unit, the warning can be monitored at several positions.

1. Position the M42 Alarm Units with relation to the M43 Detector Unit so that the commo wire lengths will not exceed the distances specified.
2. String commo wire between the M43 Detector Unit and each M42 Alarm Unit, allowing approximately 1 foot of slack at the end of the wire.
3. Tie each commo wire to the D-ring on its associated M42 Alarm Unit about 9 inches from the end of each commo wire.

4. Strip about 1/2 inch of insulation from the end of each wire.
5. Without regard to polarity, connect a wire to each binding post on the M42 Alarm Unit.
6. Repeat steps 4 through 6 above for each M42 Alarm Unit used.
7. Strip about 1/2 inch insulation from the ends of the commo wires to be connected to the M43 Detector Unit.
8. Tie each wire to the loop on the M43 Detector Unit about 9 inches from the end of the commo wire.
9. Press in one binding post on the M43 Detector Unit and, disregarding polarity, insert one strand of each commo wire into the binding post slot. Release the binding post.
10. Repeat the above step for the other binding post and remaining wire.
11. Perform start-up and operation procedures.

The section following, will discuss concepts for selecting where the detectors should be positioned and the arrays for positioning them.

SELECT EMPLACEMENT SITE AND OPERATING ARRAY USED TO POSITION FOUR- AND SIX-DETECTOR POSITIONS FOR THE AUTOMATIC CHEMICAL AGENT ALARM SYSTEM

The single most important factor in employing the Automatic Chemical Agent Alarm System is to make sure that the detector is emplaced upwind of the position or formation to be protected. The Automatic Chemical Agent Alarm System is used for the detection and warning of off-target attacks and will provide a unit with two essential elements of survival in case of a chemical agent attack when properly employed. These elements are:

- Detection of a toxic agent cloud
- Early warning to troops in the monitored position

Good judgement in emplacing the detector unit and the alarm in relation to the troop position and the surrounding terrain can mean the difference between timely detection and warning or taking unnecessary chemical casualties.

Emplacement of the System

In the fixed-emplacement installation, the M43 Detector Unit can be placed up to 400 meters from the M42 Alarm Unit. The greater the distance, the greater the warning time. However, there are practical limits to the distance. If it is too great, agent clouds that have no chance of hitting the position will be

detected. If the M43 Detectors are too far out, there is a chance of an agent cloud slipping behind them. If they are too close, the optimum warning will not be obtained. The optimum positioning of the system is to have the M43 Detector Unit 150 meters upwind of the nearest unit. For the actual location of detectors, the chemical agent delivery threat, the terrain, and the state of preparedness of friendly troops must be considered. Remember, the Automatic Chemical Agent Alarm is used for the detection and warning of off-target attacks, and it must be placed upwind of the area to be protected. The array in which the system is set up will depend on the situation and wind direction.

Detector Arrays

There are several arrays in which the Automatic Chemical Agent Detector System can be set up. Some of the arrays are explained in the following paragraphs.

Six-detector Array. The diagram below shows a company in a defensive position with six detectors deployed. The actual number of alarm systems per unit will vary depending upon the TOE. The 300-meter distance between the M43 Detectors reduces the probability that agent clouds might drift through holes in the array. This array provides a high probability of detecting an off-target attack within a reasonable warning time.

Another example shows an array using four detectors with the wind direction coming from the right flank of the unit. A significant difference between a four-detector array and a six-detector array is that with only four detectors, the array must be shifted when the wind direction shifts greater than 20 degrees. Also shown is another point which is often overlooked in chemical warfare defenses: The detector is oriented on wind direction, not on the direction of the enemy.

PREPARE AND SUBMIT NBC 1 (CHEMICAL/BIOLOGICAL) REPORTS

CONDITIONS

Given a watch, compass, map, pencil, paper and format for an NBC 1 report. A Chemical or Biological attack has just occurred. You are able to collect the following information: time attack started, location of attack, delivery means, and type of agent

STANDARDS

Within 5 minutes, submit an NBC 1 report, reporting as a minimum lines D, F, G, and H. NOTE: The other lines may be used as required by the situation and the availability of the information.

PERFORMANCE MEASURES

Initial NBC 1 (Chemical or Biological).

- Write down the time the attack started as line D.
- Write down the time the attack stopped as line E.
- Write down the location of attack as line F.
- If you can identify the attack as artillery, aircraft, or other means, write that down as line G.
- Write down type of attack, biological or chemical, and height of burst as line H.
- Give or send the report to your supervisor. If the report must be transmitted, give it a "Flash" precedence.

Subsequent NBC 1 (Chemical or Biological).

- Use the M256 kit to identify type of chemical. Determine weather conditions, wind direction, and wind speed. Provide lines D, F, G, H as before, and subsequent information not originally provided as lines E, G, H, X, Z.A., and Z.B. to your supervisor. If the report must be transmitted, give it an "Immediate" precedence.

REFERENCES

FM 21-3, Task 031-503-3005

CHARACTERISTICS OF AN NBC I (CHEMICAL OR BIOLOGICAL) REPORT

In order to identify the characteristics of an NBC I (Chemical or Biological) Report, you must be able to define terms related to the report, state the purpose of the report, and identify a chemical or biological (CB) attack.

Definition of Terms

Nuclear, Biological, and Chemical (NBC) Warning and Reporting System. This system is a standardized set of procedures for reporting NBC attacks. It ensures that all information is reported the same way. The system is one of the commander's primary means for control of unit NBC defense. There are six types of NBC reports used in reporting NBC attacks and contaminated areas.

NBC Information Source. This is a unit below division, such as a brigade, battalion, company, battery, or troop. The information source also may be an attached or supporting unit, an Air Force or other non-Army unit, or a civil agency. An NBC information source may be a unit under attack or a unit observing an attack. The source submits NBC reports.

NBC I Report. This report is used by an observing unit (NBC information source) to give initial and subsequent data of an enemy nuclear, biological, or chemical attack. It is also used to report the discovery of unreported chemical or biological contamination. (In this lesson you will study NBC I (Chemical and Biological) Reports. NBC I (Nuclear) Reports are covered in Unit 4.)

Format. This refers to the organization of information within a report. All NBC reports follow standardized formats.

STANAG. This acronym stands for Standardized NATO Agreements. These agreements determine the formats used by US and NATO allied forces to report NBC Reports, NBC Attacks and NBC Contamination. Follow the format prescribed in STANG 2103.

NBCE or NBCC. This is the NBC element or NBC Collection Center. These terms are interchangeable. The NBCE may be part of the tactical operations center (TOC) at division level or higher.

UTM. This stands for Universal Transverse Mercator Grid System. This Grid system, as modified by the Army Grid Reference System, is used to read US Army maps. All locations are given by six or eight digit grid coordinates preceded by two letters that designate a 100,000 meter square.

ZULU Time. This is Greenwich Mean Time, or the time in Greenwich, England. This time zone is used as the base for all other time zones. Local time refers to the time used in each geographic area. Either ZULU or local time may be used. Specify which time is used.

Means of Delivery. This refers to what system is used to deliver the chemical or biological agent in a CB attack. These include methods as air craft spray, bomblets from missiles, rockets, or vectors, such as insects.

Precedence. NBC reports are transmitted from unit to unit using different precedences. If a message is sent with a FLASH precedence, then no other message shall precede that message. A message with IMMEDIATE precedence will be sent after message with a FLASH precedence.

Purpose of the NBC I (Chemical and Biological) Report

NBC I (Chemical and Biological) Reports are used by the observing unit or the attacked unit to report initial and subsequent data of a CB attack to its higher headquarters. The standardized format provides a rapid means of sending the information. It does not provide a secure means. If a more secure means of sending the information is required, the commander will determine that means.

When a unit is attacked, soldiers immediately stop breathing and put on their protective masks. The alarm is given for a chemical attack. Then, the unit reports the attack to its next higher headquarters. This report is the initial NBC I (Chemical or Biological) Report. The NBC I Report must be submitted as soon as possible after the start of a CB attack. As soon as the unit has given the alarm, it must report whatever information is immediately available. After the chemical has been identified, or when more information is available, another report is submitted. This is a subsequent NBC I (Chemical or Biological) Report. More than one subsequent report may be submitted.

The NBC I (Chemical or Biological) Report will be transmitted up the chain of command. Each unit alerts its subordinate units, then transmits the report. For example, a company under chemical attack would first alert its subordinate units on the company nets with a FLASH precedence brevity code "Gas." Then the company would alert its battalion headquarters with an initial NBC I (Chemical) Report. The battalion would alert its subordinate, attached, and supporting units. Then it would submit an initial report to its brigade headquarters. This process continues until the report reaches division headquarters.

Identify a Chemical or Biological Attack

A CB attack can occur in a number of ways. Threat forces have many delivery systems capable of delivering chemical agents. These include aircraft, rockets, field artillery, and mortars. These systems can deliver both persistent and nonpersistent agents. A threat attack consisting of liquid droplets from airburst munitions or bomblets or from an aircraft, may mean persistent agents were used. Nonpersistent agents may be delivered by vapors or aerosols from point-detonation or near-surface detonation. Artillery, munitions, bombs, or bomblets also may carry nonpersistent agents.

A biological attack may be delivered by missile-delivered warheads containing bomblets. Aircraft can deliver bomblets in a variety of ways. These include releasing them all at one time, or at intervals from dispensers. Dispersing devices may eject them in various directions. Aircraft also can release bombs that contain clustered bomblets. These are released at predetermined heights by a time fuse. Spray tanks mounted on aircraft can release biological agents. A vehicle with a biological agent generator can release agents along the ground.

Observing the means of delivery is one way to detect a chemical or biological attack. Other observations may indicate that an attack has occurred. Symptoms in individuals, the appearance of dead animals, and unnatural liquids on vegetation may mean a CB attack. Swarms of vectors, such as insects, could indicate a biological attack. Color changes on M8 or M9 detector paper that has been placed on equipment could indicate a chemical attack. If an automatic chemical agent alarm sounds, an attack may be occurring.

Whenever a unit observes a CB attack or is attacked, members of that unit first put on protective masks, then sound the alarm to all sections of the unit. The unit then submits an NBC I (Chemical or Biological) Report to its next higher headquarters.

PREPARING A NBC I (CHEMICAL AND BIOLOGICAL) REPORT

NOTE

Some letters have two meanings. One meaning is used in nuclear reports. The other is used in chemical or biological reports. In this lesson, only chemical or biological letter meanings are given.

The format for NBC reports is contained in the Graphic Training Aid 3-6-3 revised IAW Ed. 5 STANAG 2103. This GTA card is pocket-sized. It is designed to be carried by the individual soldier. On the card are the formats for the various NBC reports. Also included are explanations of each alphabetical letter used in the reports.

Chemical or Biological Hazard Information

To determine the impact on the mission, commanders need accurate information on chemical and/or biological attacks. The information is used to predict vapor hazard areas. The essential information required to predict these hazards are, the date/time the attack started and ended, the location of the attack, type of munitions, and information on the weather.

Location of attack area. The location of the area attacked may be given as UTM grid coordinates or as a place. Depending on the type of attack, the attack area could be in just one location or it could cover a large area. When reporting the location of the attack area be sure to include the whole area. When using grid coordinates you may send one coordinate giving the area or send a set of grid coordinates outlining the area. You could also give a four digit coordinate to signify a whole grid square.

Kind of attack. The type of attack is very important in determining the hazard area. Different procedures are used in predicting the hazard area for different types of attacks.

Type of agent. The type of agent must be sent because different types of agents act in different ways. For example, a nerve agent can be in either liquid or vapor forms. The liquid form usually stays in the area longer than the vapor form. The NBCC needs this information to accurately predict the hazard for the chemical attack. In the initial NBC I chemical report, line item H is usually determined by watching the symptoms the soldiers are showing if casualties result from the attack. It will usually be nerve, blood, blister, or choking. For the subsequent NBC I chemical or biological report, you should use the M256 detector kit to determine the actual type of agent (i.e., G-nerve or H-blister). If the bombs are not bursting on the ground you should try to determine the height at which they are bursting (i.e., 100m, 200m, etc.) and send this information in line H of the subsequent report.

Weather information. The weather information that should be sent in a subsequent NBC I chemical or biological report is the wind direction and speed, the temperature (outside), the amount of cloud cover, significant weather phenomena, and the air stability if this information can be assessed. All this information is used to predict where the hazard will be and the duration of hazard. All this information should be given for the specific area where the attack occurred. If this cannot be done, the information would come from the current chemical downwind message that covers the area. This information is usually sent in plain language but code could be used.

- Wind Direction. When sending the wind direction, it is the direction toward which the wind is blowing. It is measured clockwise from grid north (north on a map) and should be stated in degrees or mils (mils are a unit of measure used by the artillery 6400 mils to a circle) (example - 180 deg or 3200 mils).

- Wind speed. This is how fast the wind is blowing. It is given in kilometers per hour (km/hr) (example - 15 km/hr).

- Temperature. This is for the air temperature outside in the attack area. It will be given in degrees Celsius (example - 10°C).

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- Cloud Cover. This tells how much of the sky is covered in clouds. (example-less than half, more than half, etc.)

- Significant weather phenomena. This tells what the weather is like outside in the attack area (example-raining, drizzle, snow, fog, thunderstorm, etc.)

- Air stability. This tells whether the air outside is unstable, stable, or neutral.

NBC I Chemical or Biological Report Formats

- Initial NBC I chemical or biological reports. Line items D, E, F, G, and H are normal for initial reports.

LETTER

MEANING

D	This is the date and time the attack started. It is a six digit number where the first two digits will give the day of month and the last four give the time (example-24 0900Z- the attack started at 0900 GMT on the 24th).
E	This is the date and time the attack ended. it is also a six digit number. (NOTE: If the attack lasts longer than a minute or so don't wait to send line ECHO with initial report, send it when you send the subsequent report).
F	This is the location of the attack area. It can be given as a grid coordinate or as the name of a place.
G	This is the kind of attack (guns, mortars, missiles, spray, etc.).
H	This is the type of agent and the height of burst. If the type of chemical agent is unknown send unknown. Usually line HOTEL is sent in the subsequent report after the type of agent has been determined using the M256 detector kit.

- Subsequent NBC I chemical or biological reports. Line item D, E, F, G, H, S, Y, Z.A, and Z.B. are normally for subsequent reports. As you can see, it contains the same lines as the initial report plus lines S, Y, and Z.A. Line Z.B. is optional. The information given in the initial report should be repeated in the subsequent report.

LETTERMEANING

D
E
F
G
H

Same as for initial reports

S

This is the date and time that the contamination was detected. (NOTE: This line item is also used in NBC 4 Chemical or Biological Reports).

Y

This is the downwind direction and speed. This direction can be given in degrees or mils and the speed is given in km/hr.

ZA

This line gives the temperature of the air in degrees Celsius, the amount of cloud cover, the significant weather phenomena, and air stability.

ZB

This line is for any remarks about the attack.

Prepare an initial NBC I (Chemical or Biological) report.

- Immediately upon detecting the attack, check the time and record as letter item D.

- When the attack ends, again check the time and record as letter item E. If the attack lasts over a minute, send the line in the subsequent report.

- Record type of agent if known (example, nerve, blood, blister) as letter item H. If not known use the M256 to find the type of agent and send in the subsequent report.

- Record the location of the attack as letter item F.

- If you can identify the kind of attack; example, artillery, aircraft, bomblets, record as letter item G.

- Submit the initial NBC I (Chemical or Biological) report with a "FLASH" precedence to your supervisor.

Prepare a subsequent NBC I (Chemical or Biological) report.

- Obtain type of agent from chemical agent detector kit and record in line H of the report. (for chemical contamination only.)

- Determine the direction the wind is blowing and the wind speed and record in line Y of the report.

- Determine the temperature (in Celsius), cloud cover, significant weather phenomena, and air stability conditions and record in line Z.A.

NOTE: Use plain language. The code may be used.

SUPERVISE CHEMICAL SURVEY

Situation: Given a situation in which you are to supervise a chemical survey team with all authorized NBC protection and detection equipment.

STANDARDS

- All equipment is checked for serviceability.
- Specified points, routes, or areas are checked.
- Required reports are submitted as specified by the control party.
- The presence or absence of chemical contamination is determined and, if present, the type and location of contamination are accurately reported.

PERFORMANCE MEASURES

1. Team members check all equipment for serviceability.
2. Team members check specified points, routes, or areas.
3. Team members submit reports specified by control party.
4. Team members determine presence or absence of chemical contamination.

REFERENCE

STP 3-54E2, SM, Task 031-506-2223 (TBP)

CHEMICAL SURVEY OPERATIONS

The avoidance of chemical agents requires a complete understanding of what chemical agents are, how they will be used, and what happens to them once they are employed. Units can then estimate when and where specific types of chemical agents will be used, where the hazard is greatest, and how best to avoid them.

The armed forces of the Soviet Union are equipped, structured, and trained to conduct chemical operations as well as any army in the world. So much of their training revolves around the use of lethal agents that it would be unusual, from a military point of view, if they did not use them.

The basic Soviet principle is to achieve surprise by using massive quantities of chemical agents on unprotected troops to create casualties, or on equipment or terrain to deny its use. The use of chemical weapons by the Soviets may initially require a decision at the same level as nuclear weapons, but they will most likely be used more freely once the initial use has been authorized. A general understanding of the concepts of chemical agent employment will help units avoid chemical hazards.

Classes and types of chemical agents

The Soviets classify chemical agents according to effect and classify them as six major types.

Nerve

Blood

Blister

Choking

Psycho-chemical

Irritants

These six types are divided into two major categories: persistent and non-persistent chemical agents.

Persistent.

Persistent chemical agents include nerve agents such as thickened GD (TGD), V-series nerve, and blister agents. The Soviets are known to stockpile V-series, thickened Soman (TGD), and H and L Blister for use as their persistent agents.

The objective for the use of persistent agents is to deny the use of critical terrain, canalize the attacking force, or contaminate materiel. Persistent agents produce immediate effects on unprotected troops and delayed effects on protected troops. Delayed effects occur if the agent penetrates protective clothing (either due to massive contamination or neglected contamination) and is absorbed through the skin, which produces a casualty. Left untreated, death results within 15 minutes after receiving a lethal dose.

The Soviets will use persistent agents to accomplish the following tactical objectives:

- To contaminate rear area supply depots.
- To defend avenues of approach.
- To neutralize the personnel defending a strong point.
- To protect flanks.

Nonpersistent - (Semipersistent)

Soviet forces currently stockpile blood agents, choking agents, psycho-chemical agents, and nerve agents such as tabun (GA), Sarin (GB), and Soman (GD). Nonpersistent agents should be expected across the Soviet Front, along the Forward Line of Troops (FLOT), and against units in contact with the attacking echelon. The objective of the use of these agents is to immobilize, injure, or hinder activities of the unit under attack. The Soviets also expect to reduce morale by forcing troops into a higher level of MOPP. Another advantage is that they would not need to decontaminate the area before occupying it. Nonpersistent agents are used to produce immediate casualties. They are effective through the respiratory system and in some cases, through skin absorption.

Soviets will use non-persistent agents to accomplish the following tasks:

- To create advantageous fighting conditions.
- To produce casualties prior to an assault.
- To harass troops by forcing them into a higher MOPP level.
- Allow occupation without decontamination.

Detect and Identify Chemical Agents.

The first, and probably, the most important step in contamination avoidance is detecting chemical agents. Unless this step is accomplished, none of the other avoidance steps can be taken, and the unit probably will not accomplish its mission.

Chemical agents will either be delivered directly on unit positions (on-target attacks) or delivered upwind and allowed to drift over the unit position (off-target attacks). Detecting chemical agents is different for each type of attack.

On-target attacks are the hardest chemical agents to avoid. They are designed to either produce immediate casualties or to contaminate troops and equipment. If the attack was intended to produce immediate casualties, a large amount of agent would be delivered in a very short time (within 30 seconds). Because of the reaction time of the M8 alarm, a large percentage of troops would be exposed to chemical agents before the alarm sounds. Therefore, it is not possible to warn troops of an on-target attack. Troops must either recognize the delivery of the chemical agent or the symptoms of chemical agent poisoning.

Off-target attacks are easier to protect against. Units can rely on the M8 alarm to alert the unit that a chemical agent is about to drift over their position. Protective action can then be taken before troops are exposed to the agent.

Detection is the finding of the chemical agent, preferably before any troops or equipment are contaminated. The US has several pieces of equipment that can detect and/or identify chemical agents. They are:

- M8 Automatic Chemical Agent Alarm (Detects)
- M256 Chemical Agent Detector (Detects and Identifies)
- M8 Chemical Agent Detector Paper (Detects and Identifies)
- M9 Chemical Agent Detector Paper (Detects)

Locating Chemical Agents

Chemical downwind hazard predictions provide a means of locating probable chemical hazards. Liquid agents are probably found in the attack area. Vapor hazards are in both the attack area and hazard area. Before units can avoid chemical agents, they must know what type agent is present and where it is located.

Vapor Hazards are the most difficult to predict. They may arise from an agent delivered as a vapor or from evaporation of a liquid chemical agent. The chemical downwind hazard prediction, described later, outlines the largest area and areas where chemical agent vapors still linger. Units use the automatic chemical agent alarm and the M256 sampler/detectors to locate vapor hazards.

The location of liquid chemical agents are much easier to predict. This is because they do not move around as much. It takes significant weather such as a heavy rainfall to move liquid chemical agents. Liquid agents will usually disappear from exposed areas and collect in sheltered areas. Units use detector paper to find liquid hazards. There are several methods used to locate liquid and vapor hazards. They are reconnaissance (recon), monitoring and surveys.

RECON. Recon is detecting a chemical hazard in an area before the unit moves into or through the area. All units use recon methods to locate chemical hazards. It is very similar to conventional recon. Before moving into or occupying an area, a unit checks the area for enemy activity and the presence of chemical hazards. When in a static position, units recon areas around their positions.

Equipment. The equipment for conducting a chemical recon is the same regardless of who conducts the recon. The recon element will have an ACAA, M256 Detector Kit, and M8/M9 paper.

Procedures. Recon procedures are the same; regardless, who conducts it. The purpose of NBC recon is to find the boundary of contamination and/or routes through a contamination area. Recon teams try to find the following information:

- Are there chemical agents present?
- If present, what type agent is it?
- Where was the agent first detected?
- What are the boundaries of the contaminated area?
- Is there a clear route through the area?

The unit commander can then use this information to form a picture of what chemical agents are in the area of operation. This is used to plan future operations.

Prior to leaving the unit area to conduct the recon, the recon team prepares their equipment and determines areas of priority. Areas of priority include possible movement routes and possible unit locations. The unit commander designates an area for the recon team to return to for decontamination.

The method used for a recon depends on the tactical situation and need. The commander decides how the recon will be done. Described below is how a recon is done and what decisions have to be made. Units adapt these procedures to fit their own need.

The first step is to plan the recon. The unit commander indicates areas of priority and determines approximate distances between recon checks. Initially the recon team conducts checks at 500 meter intervals. They concentrate on areas where chemical agents will collect. Low spots, small valleys, and sheltered locations are some examples.

The recon team uses the ACAA (mounted on the vehicle) to detect vapors and M8/M9 detector paper to check liquids. If necessary, the team uses the M256 sampler/detector to check a suspected vapor area. When time is critical, sampler/detector are used only when necessary.

When the team detects chemical agents, they change their procedures. They mark the area (unless ordered otherwise) then move back to a clean area. They then move laterally a predetermined distance and direction (usually 500 meters) then move forward again. This procedure is followed until they reach the unit boundary or find a clear route through the contamination.

Recording and reporting recon information. The method the team uses to report information depends on how urgently the information is needed. If time is critical, the information is passed over the radio using the NBC 4 report format. The following is a sample NBC 4 report:

NBC 4 (Chemical) Report

HOTEL Nerve, V

QUEBEC LB 195300 Liquid

SIERRA 201050Z

If time is not critical, or if radio assets do not permit passing the information over the radio, the information is recorded and carried back to the unit.

Monitoring. All units use monitoring to determine if a hazard is still present. Monitoring can be done on personnel, equipment, or terrain. Basically, it is a recheck to see if contamination, discovered by a recon or detecting an attack, still exists. The M256 detector kit is a primary piece of equipment used to monitor for chemical agents. If monitoring reveals that the chemical agent is still present on personnel or equipment, then decon operations are conducted.

Chemical Surveys. Chemical surveys are required when the commander needs detailed information on the size of a contaminated area. Unlike radiological surveys, the intensity of the contamination cannot be determined. Therefore, the prime interest is learning how large the contaminated area is and if there are clean areas or routes within the area.

Reconnaissance elements find the contaminated areas. The unit conducting the chemical survey usually knows the general location of the contamination and what type agent to expect. The unit may also know how the agent was delivered. This helps to plan the survey.

For example, the area contaminated by an artillery attack usually is less than the area contaminated by a spray attack. This information is used to determine the number of recon teams needed and the amount of time needed to conduct the chemical survey.

Time is a major factor in planning and conducting chemical surveys. The reason is the amount of time needed to complete each detection test. The majority of the testing done during a survey is with M8 or M9 detection paper. This is because the primary concern in surveys are persistent liquid chemical agents. Periodic tests are done with the M256 detection kit to ensure that only the chemical agent being tested for with the detection paper is present. The following chart gives an indication of how long a survey takes:

Example: 1/4 kilometer (250 m) target radius -

Use M256 Kit for initial test only	16 minutes
Use Detector paper for 5 minutes at four locations	20 minutes
Walking a total of approximately 800 meters	<u>24 minutes</u>
Total time for a four man team	60 minutes
Time required for total 1 km radius	240 minutes

NOTE: If the M256 Kit is required to do all test, then add 176 minutes for 1 km radius.

The size of a contaminated area is important in determining the number of teams needed to conduct the survey. The following chart can be used to estimate the size of the attack area for planning purposes only.

TYPE MUNITION

ATTACK AREA (radius)

Artillery, bomblets
and mortars

- 1 km

Multiple rocket
launchers, missiles,
bombs, and unknown
munitions

- 1 km - 2 km

Aircraft spray or
rocket spray

2 km

Techniques.

Three techniques are used to make a chemical survey. They are route, point, and area. The actual method used to survey a contaminated area depends on the situation. Routes and specific points may be surveyed if that information is needed. However, the more common technique is the area survey.

Route and point survey. These type surveys are conducted if a route or specific point is of operational concern. They are rarely conducted because this information is usually found during reconnaissance operations. If conducted, the survey team goes to a specific point or points along a route and tests for the presence of liquid contamination with M8 or M9 detector paper.

Area survey. An area survey is the primary method used for conducting a chemical survey. They are used to determine how large an area is contaminated. This information is used to determine whether to bypass the contaminated area or to cross through the area. Area surveys can also be used to find relatively clean areas within the contaminated area. This includes clean routes through the contaminated area.

If the agent identified by the detector kit is also detectable with M8 or M9 paper, then all subsequent tests are performed with detector paper. This procedure will reduce the amount of time required to perform the area survey.

The control party provides each survey team with an overlay of the area to be surveyed. It will show the area to be surveyed and initial test points for each survey team. Each team member tests with the detector kit at the initial testing point. Tests are taken every 200 meters for agent with detector paper (if agent reacts with the paper) until each team member has come within 200 meters of attack center. All team members will exit the area on the route used by the vehicle operator.

If only one survey team is used, the survey team proceeds to the next sector and repeats the procedures. If more than one team is used, the control party identifies team starting points (SP).

Recording and Reporting Procedures.

Results of a chemical survey are recorded. The important information is the type agent, location where it was detected, and the type test taken.

The method used to report the results of a chemical survey depends on the situation. Since chemical surveys take so much time to conduct, the information is usually radioed back to the control party. If time is essential, the information can be radioed back to the control party using an NBC 4 (Chemical) report.

Heading of the NBC 4 (Chemical) Report

The heading of the NBC 4 (Chemical) report consists of the following information:

Precedence. The precedence for the NBC 4 (Chemical) report is normally IMMEDIATE, however, this report may be downgraded as required or by SOP.

PREPARE AND SUBMIT NBC 4 REPORT

CONDITIONS

Given the type of agent, height of burst, location (6-digit coordinate) where sample(s) were taken, description of the samples, the date/time contamination was initially detected, GTA 3-6-3 (revised IAW Ed. 5), STANAG 2103, paper, and pencil.

STANDARDS

Prepare an NBC 4 (CB) report and submit it to your supervisor IAW the performance measures outlined below.

PERFORMANCE MEASURES:

1. Prepare an NBC 4 report.

LETTER	MEANING	EXAMPLE
	PRECEDENCE	IMMEDIATE
	DATE/TIME (LOCAL OR ZULU TIME, STATE WHICH)	061917Z
	SECURITY CLASSIFICATION	UNCLASSIFIED
	FROM	T6R67
	TO	S4M43
	TYPE OF REPORT	NBC 4 (CB)
H	TYPE OF AGENT, HEIGHT OF BURST	NERVE (V) AIRBURST
Q	LOCATION WHERE SAMPLE(S) WERE TAKEN AND DETAILS OF THE SAMPLE	FS 135648 GROUND SAMPLE
S	DATE/TIME CONTAMINATION WAS INITIALLY DETECTED	210735 (LOCAL)

a. Write down the type of agent and, if known, height of burst as line HOTEL (i.e., airburst, or ground burst). Use M8 paper or M256 to determine type of agent.

b. Write down location (6-digit coordinate), where sample(s) were taken and details (descriptions) of the sample as line QUEBEC in report (i.e., ground sample, vegetation sample, etc.)

c. Write down the date and time on line SIERRA in the report. The time can be either ZULU or Local. You must indicate which one is used.

NOTE

Lines HOTEL, QUEBEC, and SIERRA may be used as many times as necessary in the same report.

2. Submit NBC 4 report to your supervisor.

REFERENCE:

FM 21-3, Task 031-503-4004

Date/Time. The date and time that the message is sent can be shown in either local or ZULU time; however, it must be stated which time is used.

Security Classification. Normally, the NBC 4 (Chemical) report is UNCLASSIFIED; however, grid locations may require encryption when sent by unsecure means.

From. This line contains the designation of the survey team/unit submitting the report.

To. This line contains the designation of the unit or units to which the report is being sent.

Body of the NBC 4 (Chemical) Report

The information contained in each line of the body of the NBC 4 (Chemical) report is as follows:

LINE ITEM

MEANING

HOTEL

This line identifies the type of chemical agent employed.

QUEBEC

This line is used to give the location where sample(s) were taken and details (descriptions) of the samples (i.e., liquid ground sample, vapor sample).

SIERRA

The date and time the contamination was initially detected, in either local or ZULU time, is entered in this line.

When prepared for tele/electronic transmission a typical NBC 4 (Chemical) report will appear as follows:

NBC 4 (Chemical) Report
Precedence: IMMEDIATE
Date/Time: 211900Z
Security Classification: UNCLASSIFIED
From: S3R16
To: S3R16
Type of Report: NBC 4 (Chemical)
HOTEL: Nerve - V
SIERRA: 210730Z

When submitting by tactical FM it may sound like:

S3R16 THIS IS S3R29
NBC 4 (Chemical)
HOTEL: Blister - H
QUEBEC: LB 625436
SIERRA: 211615Z

PLOT NBC 5 (CHEMICAL) REPORT

CONDITIONS

Given an NBC 5 (Chemical) report, map with overlay material, grease pencil, protractor, and the requirement to plot NBC 5 (Chemical) report in accordance with FM 3-3.

STANDARDS

1. Coordinates from NBC 5 (Chemical) report are plotted on map/overlay IAW performance measures.
2. Marginal data reflects at a minimum the following: Line ALPHA, Line DELTA, Line FOXTROT, and Line HOTEL And the scale of the map used.

PERFORMANCE MEASURES

1. Accurately interpret NBC 5 (Chemical) report.
2. Grid Coordinates are plotted on map/overlay within 200 meters.
3. Marginal information is posted on overlay.

REFERENCES

FM 3-3
STP 3-54E2, SM TASK 031-506-2006 (TBP)

PLOTTING AN NBC 5 (CHEMICAL) REPORT

Contaminated Area Overlays

Recons, monitoring, and surveys locate contaminated areas. Once located, the coordinates of contaminated areas are plotted as an overlay on the situation map. Units use the contamination overlay to plan operations. Commanders determine routes, unit positions, and plan tactical operations based on where the contamination is located. If unable to avoid the area, commanders determine routes of least contamination and determine what protection is required. They also choose locations for individual and unit decontamination on the other side of the contaminated area.

When NBC 4 reports or survey data are consolidated and placed on the NBC 5 report, it shows the areas of actual contamination. Any command level that collects NBC 4 reports may prepare and send an NBC 5. Each level will use the NBC 5 overlay when planning an operation. Also, when an NBC 5 report is received, the receiving unit should remove all NBC 1-4 data from the situation map. If a unit continues to operate in the same area, periodic surveys should be conducted and the NBC 5 adjusted accordingly.

Heading of NBC 5 (Chemical) Report

The heading of the message will consist of the following information in this order:

Precedence. The dissemination precedence assigned to NBC 5 (Chemical) reports will normally be IMMEDIATE, however, it may be downgraded as required or by SOP.

Date/Time. Date and time the message is sent. It may be given in local or ZULU time, but it must be indicated which time is used (e.g. 280730Z or 280730 Local).

Security Classification. Normally the message will be UNCLASSIFIED.

From. The designation of the agency sending the message.

To. The unit or units that are to receive the message.

Type of Report. NBC 5 (Chemical).

Body of NBC 5 (Chemical) Report

The information to be entered in the body of the message is as follows:

<u>Line Item</u>	<u>Meaning</u>
ALFA	The strike serial number assigned by the NBCC upon receipt of the initial NBC 1 (Chemical) Report for the attack.
DELTA	The date and time of the attack in either Local or ZULU time. It must be indicated which time used.
HOTEL	The type of chemical agent employed.
SIERRA	The date and time the contamination was initially detected. This time may be either local or ZULU time, but the time used must be shown.
XRAY	A series of coordinates taken from the situation map along the contour outlining the contaminated area. There is no specific number of coordinates to be used. However, there should be a sufficient number to insure that when the NBC 5 (Chemical) report is posted by the subordinate unit, the contour can be drawn as accurately as possible. When the series of coordinates form a closed ring, the last coordinate should be the same as the first.

A properly prepared NBC 5 (Chemical) report is shown below.

Time: 181340Z

Precedence: IMMEDIATE

Security Classification: UNCLASSIFIED

From: E34Z19

To: W5R03

Type of Report: NBC 5 (CHEMCIAL).

ALFA: 3AD002

DELTA: 180527Z
HOTEL: NERVE
SIERRA: 180645Z
XRAY: EG038924
EG044923
EG045922
EG041918
EG039919
EG037921
EG038924

ADVISE THE COMMANDER/SUPERVISE THE CROSSING OF A CONTAMINATED AREA CONDITITONS

Given a situation where soldiers are wearing the appropriate field uniform and carrying their assigned protective masks and overgarments (to include protective gloves and footwear covers), an area designated as being contaminated, a vehicle with an M8 automatic chemical agent alarm, an operational ABC-MII decontamination apparatus, an M256 chemical agent detector kit per soldier, a map of the operational area, sandbags, chemical agent detector paper, material to protect exposed equipment.

STANDARDS

1. Advise the commander and supervise the correct performance of the before-crossing procedures appropriate for the type of contamination present.
2. Advise the commander and supervise the correct performance of the during-crossing procedures appropriate for the type of contamination present.
3. Advise the commander and supervise the correct performance of the after-crossing procedures appropriate for the type of contamination present.

REFERENCES

FM 21-3, Task 031-506-2054
Task 031-503-3004

Crossing a Contaminated Area

By-passing a contaminated area is the preferred method of operations. You will not need to wear complete protective clothing, or expend valuable time or resources on decontamination, but you may need to temporarily mask if a downwind vapor hazard exists. Your soldiers will be more psychologically prepared to fight. They will not fear chemicals that otherwise would be lingering on their vehicles and equipment. Avoiding contamination is simpler and safer than going through contamination; however, the mission may preclude this option.

The enemy wants you to become preoccupied with contamination, hoping that you will either stop your mission to decontaminate or avoid using terrain or facilities that are contaminated. To maintain your freedom of action you can perform some of the following selected actions before entering a contaminated area: separate, encapsulate, cover, and move. If you are already contaminated you must make decisions whether or not to move and how to go about it.

Separate

Leave nonessential equipment and personnel behind. If this equipment cannot be protected from contamination it may present a hazard later. If your mission includes going into a contaminated area and returning, you might consider leaving the decontamination team behind. They could then make preparations to decontaminate your unit when you return.

Encapsulate

You must prevent NBC contamination from contaminating all of your equipment. Anything carried on the outside of a vehicle will become contaminated. Consider placing vital equipment inside combat vehicles, shelters, and plastic bags or protect exposed equipment with wrappings or covers.

Encapsulate personnel in MOPP gear or collective shelters. The collective protection systems in combat vehicles needs to be activated prior to entering a contaminated area.

Cover

Tarps, plastic bags, and other containers may be used to cover equipment. When equipment must be carried across a contaminated area in an open truck, a canvas tarp will reduce the amount of decontamination necessary later. If the equipment is left in its original containers (such as ammo cans), this may further reduce or eliminate decontamination requirements. A protective coat of earth may also ease your decontamination work after crossing a contaminated area. The earth will more readily absorb the contamination minimizing absorption of the chemical agent into the paint.

Move

Take immediate action to determine the type of hazard and its persistency. If the hazard is nonpersistent (blood or nonpersistent nerve agent), the unit continues its mission in place -- the hazard will disappear quickly. If the hazard is persistent (nuclear fallout, suspected biological agent, or liquid chemical agent), the unit maintains full protection and takes actions to limit further exposure to the hazard, and continues the mission. Simultaneously, the commander analyzes the unit's situation to determine if immediate relocation to clean alternate location is necessary or possible. Primary considerations are given to:

- The area contaminated (i.e., given in the Chemical Downwind Hazard Prediction, the NBC 3 (Chemical) and/or NBC 5 (Chemical) report).
- The current tactical situation.
- The protection offered by present position.
- The increased exposure to the hazard that would be caused by relocation.
- The possibility of further NBC attack.
- The degree of decon required.
- The subsequent impact of continuing to fight in partial or full protection.

If the decision is made to remain in place, the contamination hazard must be minimized or avoided to the maximum extent possible.

Preparation to relocate is started as soon as possible, if the contamination problem cannot be easily or quickly resolved. Movement to a clean, alternate position may involve considerable movement distances depending on the unit's mission, the tactical situation, and terrain feature. During relocation, every effort is made to avoid further exposure to the contamination hazard.

Select a route or path through the contaminated area that provides freedom of maneuver and minimizes contact with contamination. You must always move tactically. You will have difficulty locating snipers and booby traps, because your vision is hampered by wearing protective mask. Do not abandon tactics because you are in a contaminated area.

Unit reconnaissance personnel should be ahead of your unit checking for clean paths or areas. If required to cross a contaminated area, minimize contact by avoiding vegetation such as small trees, brush, and tall grass. The faster you can get across, the shorter will be your contact with contamination and the less chance that it will be absorbed into your equipment. Also, consider decontaminating a path. Setting the contaminated path on fire creates an immediate vapor hazard but will reduce the contact hazard. Engineers can reduce the contact hazard by using earthmoving equipment to clear a path. The hazard on hard surfaces can be reduced by flushing them with water or covering them with clean material such as earth. Decontamination units are also capable of limited decontamination of hard surfaces.

Even with these methods, there will still be a vapor hazard near the decontaminated area. These methods have drawbacks because they are time consuming and require equipment and supplies not organic to a unit.

Upon clearing the contaminated area, decontamination is performed, as mission allows, to include requesting additional decon support if required. Unit continues mission while maintaining readiness to react to additional conventional or NBC attacks.

DETECTION METHODS FOR BIOLOGICAL AGENTS

The detection of biological agent attack is a requirement of an adequate defense system. Of primary concern is detection of biological agent aerosols which offer the most effective method of dissemination. Unlike nuclear weapons and chemical agents, biological agents are living. They are not detectable with the five physical senses.

Detection can be subdivided into phases that provide information upon which maximum individual and collective protective measures can be taken. These phases are as follows:

- Rapid warning to indicate that an attack is taking place,
- Sampling to provide the material necessary for identification and, in some cases, to help determine the extent of contamination,
- Identification to identify the agent and help determine proper therapy for exposed personnel, and
- Epidemiology to determine the extent of agent effect throughout a unit or geographical area.

Rapid Warning. Rapid warning requires the use of some type of automatic device (or devices) to give an immediate indication that biological agents have been used. A device of this nature must be extremely sensitive to detect very small amounts of agent, and reliable in order to reduce the possibility of false alarms. Currently, the US Army inventory does not possess such a device, although several prototypes are in various stages of research and development. However, a warning may be provided by other means, such as the pattern of established warfare or recognition of the delivery system used. These could give the commander an indication that an attack is in progress.

Pattern of Established Warfare. After biological agents have been employed several times, a definite pattern of usage could materialize. The time of attack, methods of dissemination, munitions, or the stage of the operation in which the agents are employed might be similar. This information will not give definite proof that a biological attack is occurring; however, if the suspected action closely parallels previous known attacks, a warning could be given.

Intelligence. Intelligence can yield information useful in predicting a biological attack.

- Strategic intelligence could give the commander an estimate of the enemy's overall capabilities, limitations, and probable intentions for the employment of biological agents.

- Combat intelligence could give the commander an estimate of the enemy's battlefield readiness to employ biological agents.

- Technical and medical intelligence also have application. Technical intelligence could enable evaluation of the protective equipment of an enemy and determination of its availability of forces. Medical intelligence might provide information concerning the status of enemy preventive medicine capabilities, medical treatment capabilities, and preparations being made in medical and related areas which might indicate imminence of attack with biological agents. For example, the extent of an enemy's immunization program might be analyzed by methods which include serum analysis (determination of antibody content in POWs and examination of captured immunization records).

Sampling. The purpose of sampling is to aid in the identification of an agent by obtaining a large number of viable microorganisms relatively free from interfering materials. Sampling will be accomplished by individuals trained in sampling procedures so that uniformity will exist in the samples and the sampling data forwarded to identification personnel. Sampling must not be done indiscriminately but will be performed only after some indication that an attack has taken place. The US Army standard A sampling kit is the M34 CBR Agent Sampling Kit.

Methods of collecting suspected material vary with its nature and source; that is, living or dead tissue, body secretions, water, and material from surfaces of all kinds. Sampling also varies with the method of agent release, such as aerosols from spray devices or bombs. If the agent is released as an aerosol, every effort should be made to obtain a swab sample as near the point of release as possible. The number, as well as the viability of the microorganisms in an aerosol, will decrease progressively with the passage of time and with increasing distance from the point of release.

Samples of vegetation, water, and other material on which the agent has impacted may be of value in helping confirm the identity of the agent even though the samples contain interfering contamination and yield a smaller number of microorganisms than were present in the original aerosol. Such samples should be taken as soon after release and as near the point of release as possible. Vegetation, water, and other solid and liquid samples are collected by placing contaminated portions of each in sterile containers. Samples from contaminated surfaces may be obtained by rubbing the surfaces with a sterile, moistened cotton swab and then placing the swab in a sterile, capped container.

Samples should be sent to the nearest designated laboratory for identification by the fastest method available.

Identification. The identification of microorganisms is a difficult and time-consuming process. The methods used are generally dependent upon obtaining living organisms by sampling.

The identification phase of detection is accomplished to determine which of the possible antipersonnel agents was used in the attack. Identification can aid in the following:

- Confirming that an attack has taken place.
- Determining the proper therapy to combat agent effects on exposed personnel.
- Estimating the expected number and type of casualties in the command.
- Determining the time-to-casualties if the time of the attack is known.
- Evaluating an enemy's biological capability.

Laboratory procedures are used to establish or confirm the identity of a microorganism.

Epidemiology. Epidemiology is the study of the community aspects of disease and is employed particularly during epidemics or sudden outbreaks of disease. Epidemiology is the least desirable phase in determining that a biological attack has taken place from the standpoint of time; however, at the present time, it is the most positive. A considerable amount of time may be consumed before significant information would be obtained. It is, therefore, limited as a source of information upon which prompt defensive measures can be based. When a large number of cases of a disease suddenly appear within an area, an investigation is conducted to determine the cause. If all natural causes for the outbreak can be ruled out, an assumption can be made that a biological attack has occurred. Initial biological attacks would probably be detected by epidemiological findings of the Army Medical Service or the Air Force Medical Service.

USE THE NBC MARKING SET

CONDITIONS

Given a situation requiring the marking of a contaminated area, and an NBC Marking Set.

STANDARDS

Select the correct marker, fill it out completely, and emplace the marker in accordance with the performance measures listed below:

PERFORMANCE MEASURES

1. Emplace on object.
2. Mount on mounting stake.
3. Emplace as part of large area marking requirement.

USE NBC MARKING SET

The NBC marking set is a recent addition to the chemical defense equipment inventory. It was originally invented by the Germans and subsequently purchased by the US Government, i.e., the (12) in the National Stock Number, NSN 9908-12-124-5955. Below is a description and location of the major components of the set, itself. All major components can be reordered. Don't discard the set. All stock numbers for replacement parts are found on the inside of the set under rolls of flags. Like the M256 Chemical Detection Kit the NBC Marking Set is issued at squad level.

OPERATING INSTRUCTIONS

Use carrying straps to wear marking set so it is comfortable for you. Generally it is best to wear set on front when working alone and on back when working in teams.

Front wear. Loop top carrying strap around shoulders. Make sure ribbon container is at bottom as shown. Unhook bottom carrying strap and loop around waist. Rehook bottom strap to carrying container. Adjust straps so set is snug.

Back wear. Put arms through carrying straps as shown below. Make sure crayons are at top. Adjust straps so set is snug.

FLAG CONTAINERS

Each container holds 20 Marking flags:

20 white flags for marking nuclear contamination.

20 blue flags for marking biological contamination.

20 yellow flags for marking chemical contamination.

RIBBON CONTAINER

Holds 13 separate rolls of yellow marking ribbon.

Ribbon used to provide a way to hang flags between poles or other objects

CARRYING CONTAINER

Holds all individual parts of set.

Carrying straps can be adjusted for front or back wear.

MOUNTING STAKES

48 stakes stored in bottom of carrying container

Used to make poles for hanging flags and attaching marking ribbon.

CRAYONS

Red crayons used to mark information on flags.

Mark Radiologically Contaminated Area

Place signs on all probable routes leading into contaminated area at the point where the dose rate reaches 1 rad per hour measured at 1 meter above the ground. When the dose rate is above 1 rad per hour or when a CB hazard is located, signs showing the actual dose rate or agent are placed on all probable routes leading into the contaminated area at the boundary.

Secure the signs above the ground, right-angled apex downward, on wire-boundary fences, trees, rocks, or poles, or by putting the apex into the ground. This latter method should not be used if the other methods can be used, as the signs can be obscured by grass and other undergrowth, and they can be knocked down. The front side of signs are posted facing away from the area being marked. When signs are posted within a contaminated area, the sign will face away from the area of higher dose rate, or higher concentration, if this can be determined.

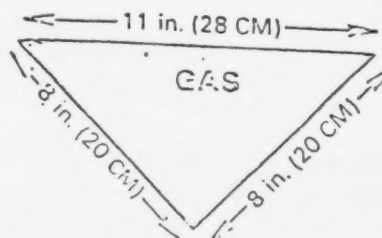
For marking contaminated areas, the following information is put on each sign:

DOSE RATE
DATE AND TIME OF READING
DATE AND TIME OF BURST



Mark a Chemically Contaminated Area

AGENT - BLISTER (HD)
DATE - 22 SEPT
TIME - 10000Z



Mark an Area of Biological Contamination

AGENT - ANTHRAX
DATE - 23 SEPT
TIME - 1200Z



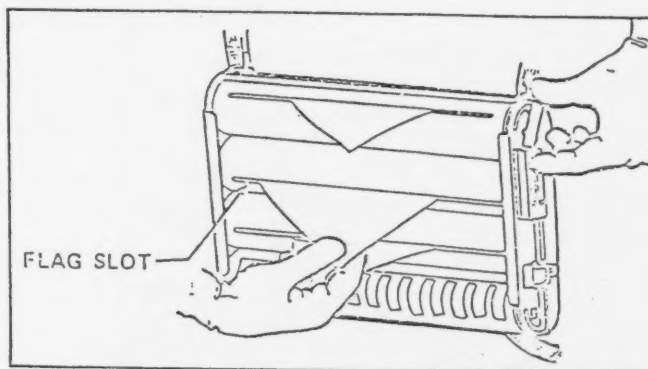
Illustration of Marking Contaminated Areas Using the NBC Marking Set

NOTE

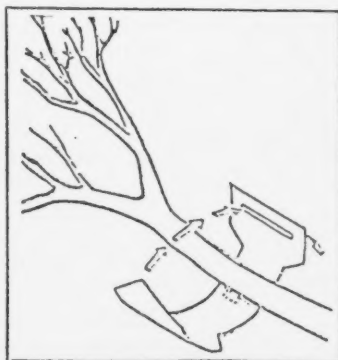
Flags may hang up inside flag container. Pry apart flag slot with point of stake and pull flag out slowly.

1. Pull flag from container:

- white for nuclear contamination
- blue for biological contamination
- yellow for chemical contamination

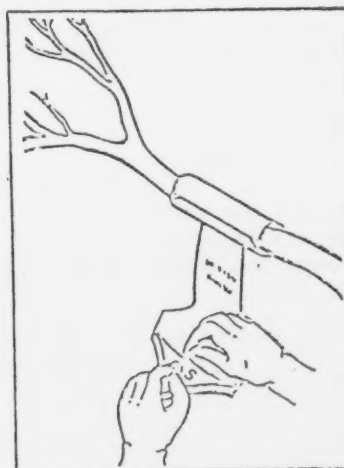


3. Mark required information on neck of flag with crayon to holder.



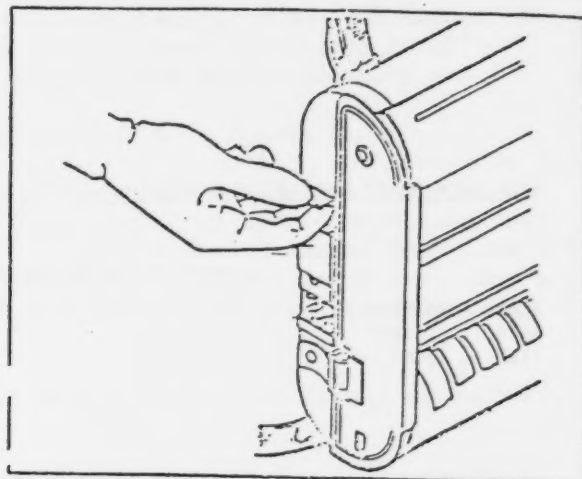
4. Attach flag to object.

crayon from side of marking set.

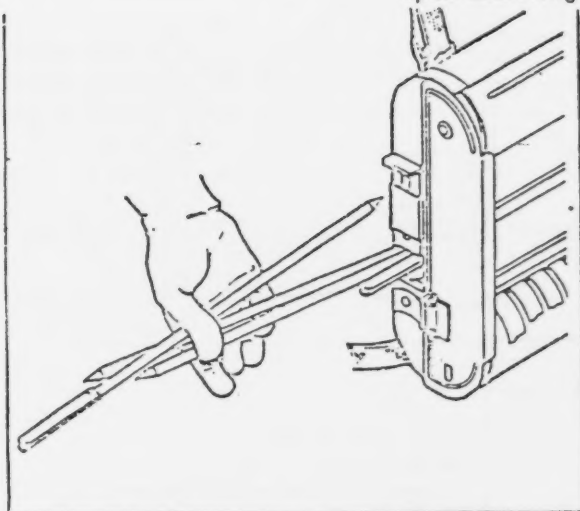


WARNING

Be careful when using mounting stakes. Stakes could tear C-B protective clothing.



Open mounting stake access latch.



2. Remove at least three stakes to make a pole.

NOTE

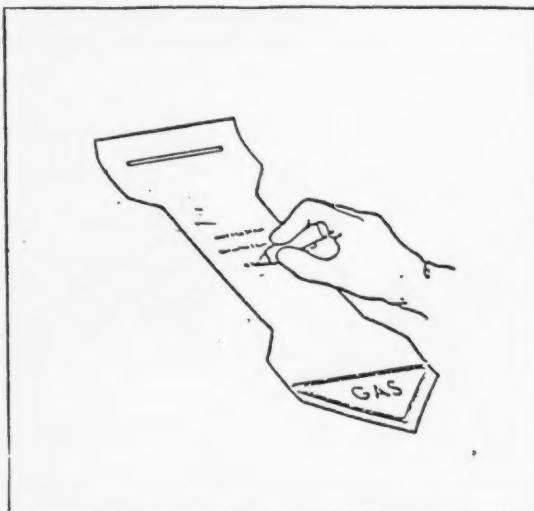
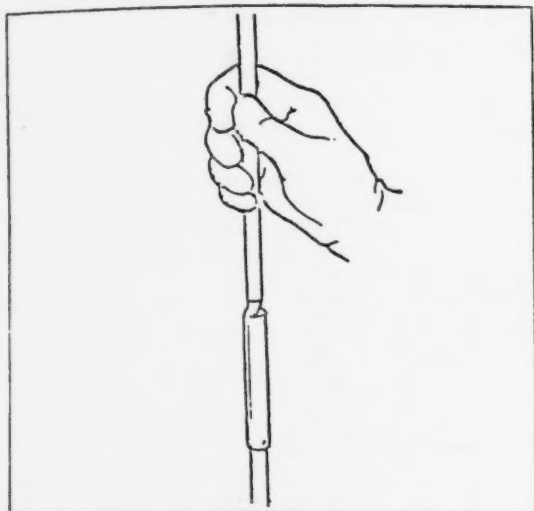
Do not use more than four stakes together. Pole Bends too easily with five stakes.



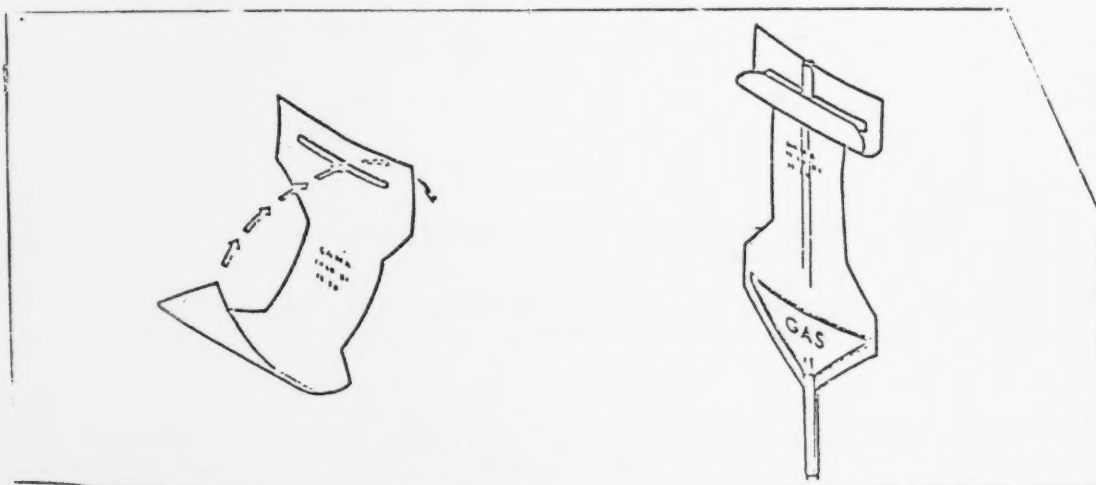
3. Stick first stake in ground next to object or area to be marked.

NOTE

You may need to pound first stake into ground using a rock or other object. This will damage stake but will start a hole in which to place an undamaged stake. Keep damaged stake to use as a tool for starting holes for other stakes.



4. Add two stakes to first stake. For more height, such as in bushy areas, add one more stake.
5. Pull out flag and mark with crayon as shown in example 1, steps 1-3.

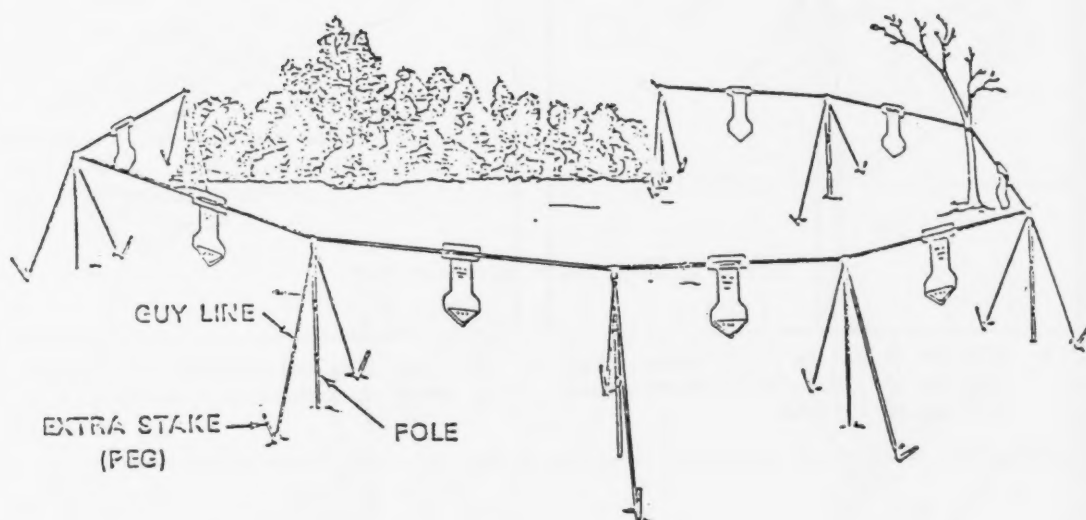


NOTE

Make sure lettering on flag-faces away from contaminated object or area.

6. Fold and attach flag to pole using slit at top of flag.
7. Tuck bottom tip of flag into slit of mounting stake.

WARNING
Be careful when using mounting stakes. Stakes could tear C-B protective clothing.



NOTES

This illustration shows marked off area when finished.

Use natural or man made objects such as trees or fences as poles if these are available.

1. Make up and place pole in ground.
2. Lay two extra stakes next to pole.
3. Repeat steps 1 and 2 for each pole you need to surround contaminated area.

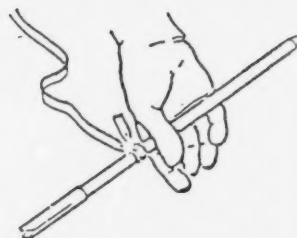
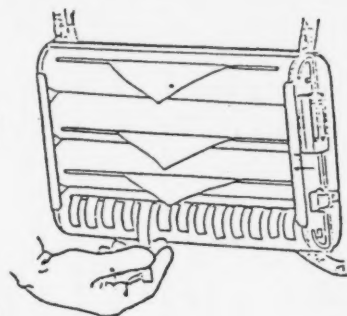
NOTE

Poles should be about 5 to 6 feet apart.

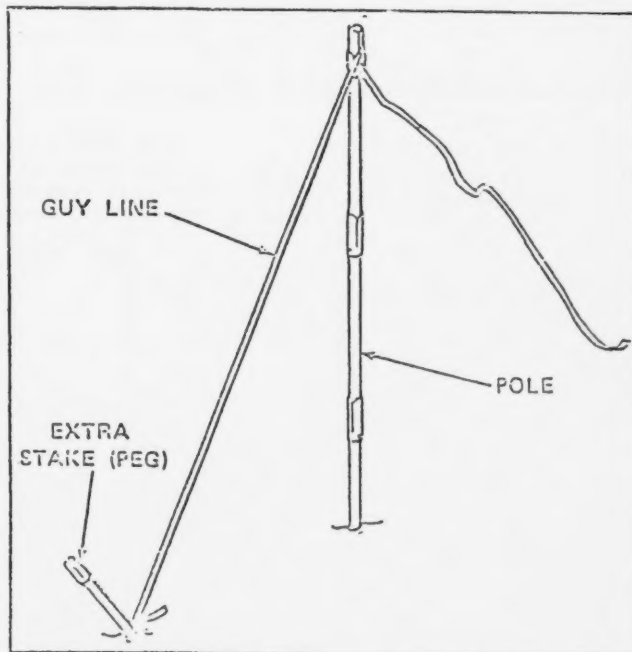
4. Make guy lines for each pole as follows:

NOTE

Ribbon may roll back inside container. Use point of stake to reach inside opening and pull ribbon back out.



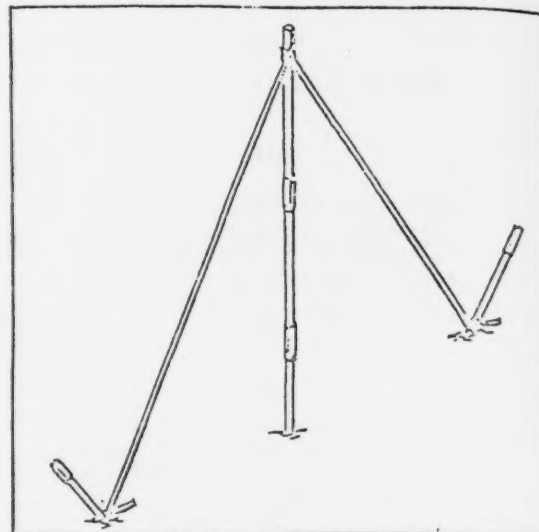
- a. Tie end of one ribbon roll to one of the stakes left out for use as a peg. Do not tear off ribbon yet.



- b. Stick peg in ground about 1 1/2 to 2 feet from pole.
- c. Keep pulling out enough ribbon to reach top of pole and slide ribbon into slit at top of pole.
- d. Loop ribbon around pole once and keep pulling out enough ribbon to reach about 1 1/2 to 2 feet on opposite side.

e. Tear ribbon with hands and tie to second extra stake

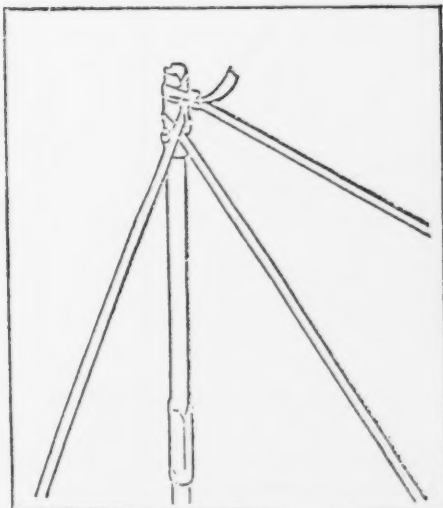
f. Stick stake in ground.



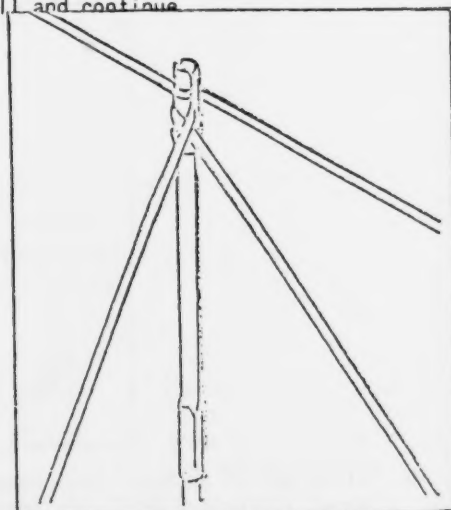
5. Connect each pole with ribbon as follows:

NOTE

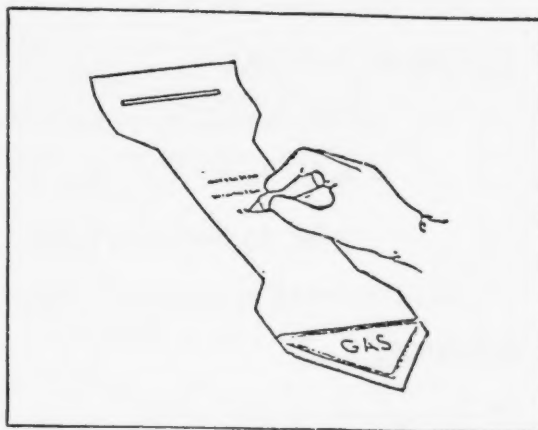
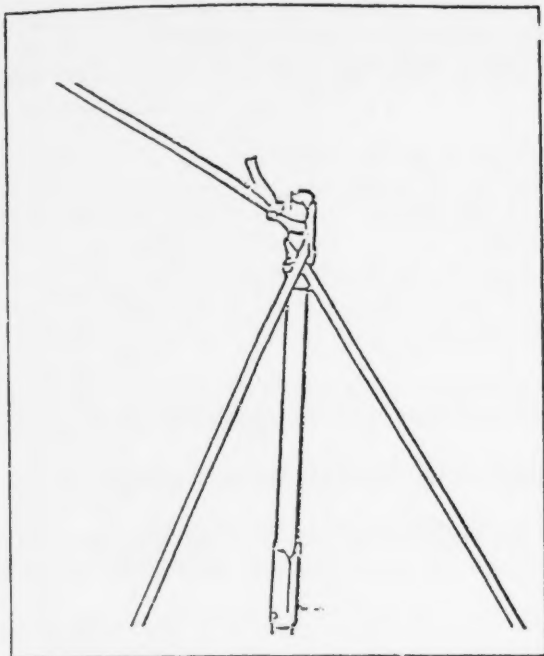
If your ribbon roll runs out, tie end of ribbon to new roll and continue



a. Pull out ribbon and slip end into slit at top of first pole and tie a knot. Do not tear off ribbon from roll yet.

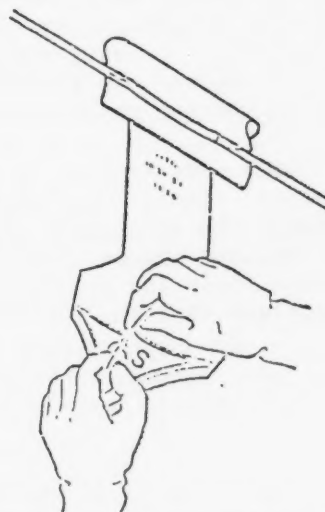
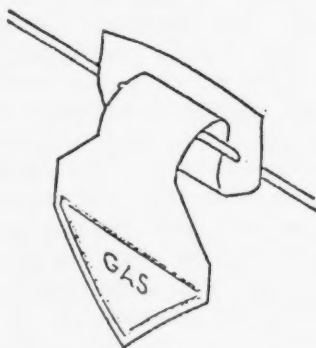
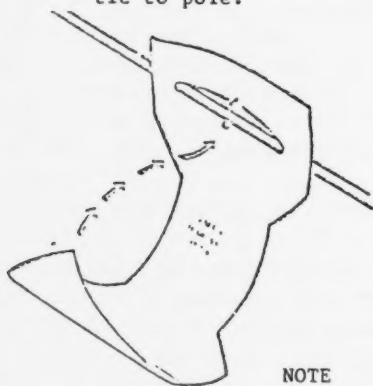


b. Keep pulling out ribbon and connect each pole by sliding ribbon into slit and making one keep around pole.



c. When you have reached last pole tear off ribbon with hands and tie to pole.

6. Pull out flag and mark with crayon as shown in example 1, steps 1 thru 3.



NOTE

Make sure lettering on flag faces away from contaminated area.

7. Attach flag to stretched cut ribbon.

8. Fold flag from its bottom tip to top of printed triangle, this will keep flag from curling.

CONDUCTING UNMASKING PROCEDURES

CONDITIONS

Assume that you are the senior ranking soldier in a group of soldiers. You and the soldiers are in mission-oriented protective posture (MOPP) level r. Chemical agents may have been used. An M256 chemical agent detector kit may or may not be available.

STANDARDS

The initiation of unmasking procedures is performed in the proper sequence and in accordance with FM 3-4.

PERFORMANCE MEASURES

1. Conduct unmasking procedures.
 - Refer to FM 3-4, Chapter 5 when a detector kit is available.
 - Refer to FM 3-4, Chapter 5 when detector kit is not available.
2. Completes appropriate unmasking procedure within 45 minutes.

REFERENCES:

FM 21-3, Task 031-503-3002

CONDUCT UNMASKING PROCEDURES

The protective mask not only must be put on in time, it must also fit and function properly. In combat, platoons and companies must have rigorous mask inspections at least weekly and should check mask functioning occasionally with CS agent. This can be done quickly and easily in an assembly area by having the men mask and stand in the cloud from a CS grenade.

Although your protective equipment will provide effective protection against chemical agents, maintaining a high MOPP (mission oriented protective posture) reduces the efficiency of the unit and its ability to perform its mission. In hot weather the heat stress caused by wearing protective equipment, particularly the protective mask, can cause heat casualties. Thus, it is important that the MOPP be reduced as soon as it is safe to do so.

Unmasking must be careful and deliberate. This is especially true today because modern toxic chemical agents, such as nerve agents, kill or incapacitate in very diluted amounts. Unmasking should not be considered until all visible signs of the chemical agent have disappeared. Even then, units should wait for a buffer period of time before beginning the unmasking procedure. This buffer period is important because chemical vapors can be trapped in clothing or tentage fabric and can be given off for several hours after the attack.

The procedure to be followed in determining when it is safe for troops to unmask depends on whether an M256 Chemical Detector Kit is available.

NOTE

Initiating unmasking procedures is a command decision. After a chemical attack, troops do not unmask until authorized by the commander or ranking individual present.

You will be required to use the following procedures to advise your unit commander when to unmask.

UNMASKING PROCEDURE WITH A CHEMICAL DETECTOR KIT AVAILABLE

Unmasking procedure. If an M256 Chemical Detector Kit is available, it should be used to determine the presence or absence of chemical agents.

When the detector kit indicates the absence of chemical agents, the procedure used to verify that agents are not present, before allowing troops to unmask, is as follows:

Step 1. Select two or three soldiers and examine them to make certain they exhibit no chemical agent symptoms, particularly pinpointing (contraction) of the pupils, indicating exposure to nerve agents. This examination should be conducted in a shaded area, since bright light will cause contraction of the pupils, which could be misinterpreted as a nerve agent symptom.

Step 2. If the selected soldiers exhibit chemical agent symptoms, administer first aid. Select and examine substitutes until you have two or three who exhibit no chemical agent symptoms.

Step 3. Have the selected persons unmask in a shaded area. Examine them for chemical agent symptoms for five minutes. If symptoms appear, have them remask immediately and administer appropriate first aid.

Step 4. After five minutes have elapsed and no symptoms appear, have the soldiers remask. Examine them continually for ten minutes in a shaded area. If no symptoms appear, advise the unit commander that it is safe for the remainder of the troops to unmask.

UNMASKING PROCEDURE, CHEMICAL DETECTOR KIT NOT AVAILABLE

If a chemical detector kit is not available, use the following procedure to determine if it is safe to unmask.

Step 1. Select two or three soldiers and check them, in a shaded area, to be sure they exhibit no chemical agent symptoms.

Step 2. Have the selected soldiers take a deep breath and hold it, then break the seal on their masks for 15 seconds, keeping their eyes open. After the 15 second exposure, have them reseal and clear their masks.

Step 3. Examine the selected soldiers, in a shaded area, for ten minutes. If chemical agent symptoms appear, administer first aid and advise the commander that the troops should remain masked. If no symptoms appear, proceed to the next step.

Step 4. Have the same soldiers again break the seals of their masks, take two or three normal breaths, then reseal and clear their masks.

Step 5. Examine the soldiers as before, in a shaded area, for another ten minute period. If no symptoms appear, proceed to the next step.

Step 6. Have the same soldiers unmask for a period of five minutes and remask. Examine them for chemical agent symptoms and remask.

Step 7. If symptoms appear, have them remask immediately, administer first aid, and advise the commander to have the troops remain masked. If no symptoms appear, continue to examine the soldiers for another ten minute period, if they still do not exhibit symptoms, advise the commander that the remainder of the troops may unmask. However, all troops should remain alert particularly for the appearance of any chemical agent symptoms.

You will be required to advise the unit commander regarding the safety of allowing the troops to unmask after exposure to chemical agents. Remember, unmasking is a command decision. If command guidance is not available, the decision to unmask is made by the ranking person present.

SUPERVISE PARTIAL DECONTAMINATION

1. GENERAL: In this lesson you will learn the operational concept of emergency and partial decontamination. The discussion of partial decontamination will be limited to two techniques; personal wipedown and operator spraydown. Discussion of partial decontamination will be further expanded later. The procedures you will learn are completed by the individual and meant only to permit survival and limited sustainment for the individual and individually assigned equipment. These operational concepts are the least costly methods of decontamination in both time and resources.

2. TASKS: This lesson contains one task.

Decontaminate using ABC-MII Decontamination Apparatus.

3. REFERENCES:

FM 3-5

FM 21-2, Task 031-503-1007

FM 21-3, Task 031-503-2002

TM 3-4230-204-12&P

4. LEARNING AIDS:

ABC-MII Decontamination Apparatus
M58AI Skin Decon Kit

UNIT DECONTAMINATION

This lesson was rewritten IAW the new decontamination field manual, FM 3-5. This manual, FM 3-5, has defined and clarified the process of nuclear, biological, and chemical decontamination. It shows how contaminated forces survive, sustain, or restore their combat potential when contaminated.

FM 3-5 makes fundamental change in the emphasis of decontamination. It emphasizes decontaminating just enough to keep fighting, rather than enough to make a contamination-free environment. This means most decon will support the partial decon concept, the point of which is to sustain the fight. It will be done in or very near the area of operation with decon squads from divisional corps chemical companies reinforcing the decon effort of contaminated units.

Other important changes in the overall decontamination concept include:

- A chemical platoon will be required to support detailed equipment decon operations. Previous doctrine stated that a squad would support this size decon operation. Battalion-size units will require the support of a full chemical equipment as well as that to be fielded in the near future.

MI2A1 Power-driven Decon Apparatus.

XMI7 SANATOR.

XMI8 Diesel-powered Decon Apparatus.

XMI6 Jet Exhaust Decon System.

- The term MOPP gear has been adopted for what has been called the chemical protective ensemble. It includes all of the things necessary for a soldier to assume a protective posture:

Chemical protective suit (overgarment).

Chemical protective footwear covers (overboots).

Chemical protective gloves (rubber gloves).

Protective mask (field, tank, or aviation versions).

Protective mask hood.

Chemical first aid antidotes.

Skin decon kit.

Detector paper.

- The shower requirement in personnel decon has been dropped. There were many reasons for this. Some are:

1. Research has shown that showering may be ineffective or even detrimental. Some agents are so lethal that you must shower within minutes of getting them on you skin or you become a casualty. Some research shows that showering will even speed an agent's penetration of the skin.

2. New MOPP gear undressing procedures have been developed. When done properly, they allow little or no agent transfer. This eliminates the need for showering to remove agents from the skin.

3. The Army has replaced impregnated undergarments with chemical protective suits (overgarments). This has eliminated the need for a shower to remove the irritating compounds that the undergarments leave on the skin.

- The slurry pit has been deleted from the equipment decon station. The new procedure calls for a more thorough initial wash. This is followed by the application of a decontaminant over the entire outer surface, including the undercarriage. This change eliminates the logistic burden of a slurry pit.

- Interior decon has been added as an additional step in the equipment decon operation. The need exists to remove agent inside the vehicle as well as outside. The procedures given in FM 3-5 use currently available equipment. These procedures will be modified when forthcoming interior decon systems, such as the XM15 hot air interior decon system, have been fielded.

- Aviation decon procedures have been developed. They use the functional areas of Army aviation as the primary determining factor for the type and extent of decon. Refer to FM 3-5 for details on aviation decontamination.

Contamination from an NBC attack shouldn't be thought of as an "insurmountable problem". On the modern integrated battlefield, soldiers will have to deal with this contamination in order to fight and win. In the event of NBC contamination, commanders will have to adjust their combat operation, the same way as they do for other factors such as bad weather or shift in enemy forces.

During the escalation of future conflicts with the WARSAW Pact countries, contamination is a distinct possibility. Therefore, with this in mind, you must assume that as soon as NBC attacks have been initiated, your combat potential lessens.

Anyone who has ever worn MOPP gear knows that it is hot and uncomfortable and that it reduces job performance. While most everyone knew that the gear would have some effect on a unit's combat performance, no one knew just how much.

A new Army study is changing that. Initial results have come in from the chemical and nuclear environment field test (CANE I). Although the results are not conclusive, the following trends were revealed:

- A mechanized infantry platoon attack took twice as long when in a chemical environment. All infantry attacks will probably take longer in a chemical environment.

- More soldiers were required to inflict the same damage on an enemy in a chemical as opposed to a conventional attack. It took at least a four-to-one superiority compared to a three-to-one superiority to guarantee a 50 percent chance of success.

- Casualties increased. Infantry soldiers were at least 15 percent more likely to be killed in an assault.

- Command and control difficulties increased. Confusion contributed to this. Someone assumed control only 20 percent of the time on a platoon leader's death instead of 80 percent in conventional combat.

- Some weapons and weapon systems seemed less effective. With both attackers and defenders in MOPP gear, the following facts were noted:

- M16 kills down by 25 percent.

- LAW and DRAGON kills reduced 75 percent.

- Machine gun kills remained the same.

- Artillery kills appeared to be twice as effective.

- Fighting forces may not be able to operate effectively in MOPP 4 for much more than 72 hours.

- Severe dehydration effected over 17 percent of infantry soldiers while 83 percent of remainder were close to dehydration (although they were unaware of this).

Consider being in a contaminated area whether it be contaminated with radiological, biological, or chemical hazards. You as the individual are confronted with the possibility of having to decontaminate yourself and individual equipment to continue your mission successfully. Placing yourself in a leader role compounds these thoughts even further having now to decontaminate your vehicles and crew served weapons. As you progress up the leadership chain, the problem remains the same, however, the time and resources to be gathered to decontaminate escalates significantly. Therefore, the decision to decontaminate must be made within the realm of the tactical situation. The tactical situation, of course, will dictate how much you as an individual and leader can decontaminate or adjust the MOPP level.

There are certain principles that must be followed when thinking of decontamination. The more decon you do, the more expensive it is in resources, manpower, materials, and time. Those same resources are used to fight the enemy, so commanders must expend these resources wisely. The best way to conserve those resources is by following these basic principles:

- Decon as soon as possible. The sooner you decontaminate, the sooner you can reduce your MOPP.

- Decon only what is necessary. If you're expecting to survive and win, don't waste your valuable time and resources decontaminating everything.

- Decon as far forward as possible. Don't truck your contaminated personnel and equipment out of your operational area. If at all possible, bring the decon assets to the unit.

- Decontaminate by priority. This principle, although last in the decon concept, is highly important. The best way to set your priorities is to decon the important things first and less important things last.

Choosing what techniques use for decontamination should be a tactical decision. There are seven standard decon techniques that progressively help restore units combat potential. The more techniques you use to decon, the more you enhance your combat potential. On today's modern battlefield, decon assets will be in great demand. Your commanders should plan for decon operations and concentrate their decon assets where they can best support the battle. Commanders should take into consideration what levels of decon exist. With the implementation of new decon equipment, the commander will have to choose if he/she can rely on company decon assets, needs decon assistance from battalion level, or undergo full scale decontamination operations supported by divisional chemical company. Commanders will also have to consider the cost and time requirements. As far as cost goes, it will be necessary to examine the concepts of decontamination. Those concepts being emergency, partial, or complete.

NBC OPERATIONAL CONCEPT

DECON TECHNIQUES

EMERGENCY

Survival of combat potential
(individual soldiers)

Skin Decon

PARTIAL

<u>Sustainment</u> of combat potential	Personal Wipedown
of the contaminated force	Operator's Spraydown
by allowing it to continue	MOPP Gear Exchange
the battle	Vehicle Washdown

COMPLETE

<u>Restoration</u> of combat potential	Detailed Troop Decon
of the force by eliminating	Detailed Equipment Decon
the need to use MOPP 3 or 4	

DECONTAMINANTS

A decontaminant is anything that is used to reduce the hazard from NBC agents to an acceptable level. The three types are: standard, natural, and nonstandard decontaminants.

Standard Decontaminants: STB and DS2.

WARNING

STB and DS2 should never be stored together. Mixing the two will cause a fire.

Decontaminating agent, STB (Supertropical Bleach). Decontaminating agent, STB, is commonly referred to as supertropical bleach, or bleach. Supertropical bleach is a mixture of chlorinated lime and calcium oxide in a white powder form. When manufactured, it contains about 30% available chlorine, which give it a characteristic pungent odor. STB is corrosive to most metals and injurious to most fabrics. A protective mask and rubber gloves must be worn when dryhandling bleach.

STB decontaminates mustard, lewisite and nerve agents by converting them into harmless or less toxic compounds. Full strength STB reacts violently with liquid mustard and usually produces sufficient heat to cause a flame. STB may be applied directly to surfaces contaminated with liquid mustard by diluting the mixture with water. Mixing STB with water or earth facilitates its distribution and reduces the temperature resulting from its reaction with liquid mustard. STB does not react with liquid chemical agents after they have been absorbed into the ground or other porous materials because it cannot come into contact with the agent. However, as long as STB retains its chlorine content, it serves to seal the chemical agents or to neutralize the vapors as they rise from the contaminated surface. Since STB decomposes, the covering should be renewed at least every 24 hours. If the seal is broken by abrasion, the vapors will again become a hazard, and the STB covering must be renewed.

STB is used to decontaminate rubber, terrain, canvas, wood, or other types of materials. Bleach mixtures (dry mix and slurry) do not decontaminate mustard HD effectively at temperatures below 14°C (57°F), the freezing point of HD mustard. If camouflaged properly, STB can be left on most surfaces after use. However, STB should be rinsed from metal surfaces soon after application to avoid damage to the metal. The metal surfaces should then be oiled or greased to prevent corrosion. However, STB must never be used to decontaminate ammunition. On wood or other porous surfaces, several applications of STB may be necessary as determined by testing. When testing has determined that decontamination is adequate, wooden surfaces may be flushed with water to remove slurry.

- Slurry. There are two types of STB slurry, one for applications by hand and the other for application by a Power Driven Decontaminating Apparatus (PDDA). When swabs, brushes, or brooms are used to apply slurry, it is best to mix equal parts (by weight) of STB and water. For example, one drum of STB (50 pounds) mixed with 6 gallons of water (48 pounds) would make an effective slurry.

- Dry Mix. Dry mix consists of STB mixed thoroughly with dry earth, sand, or ashes. The proportions by volume are 2 parts (2 shovelfuls) of bleach to 3 parts (3 shovelfuls) of earth, sand, or ashes. Dry mix is used to decontaminate chemical contaminants that are washed from vehicles and equipment. It is also used to decontaminate the soles and heels of boots.

Decontaminating Agent DS2. DS2 is a clear solution consisting of 70% diethylenetriamine, 28% ethylene glycol monoethyl ether, and 2% sodium hydroxide. It is a general purpose decontaminant. DS2 is degraded by water and carbon dioxide in the air. A partially used container should not be kept for further use after 24 hours.

- DS2 is available in 1 1/3-quart cans and 5-gallon drums in ready-to-use solutions. The 1 1/3 quart cans are filling the ABC-M11, 1 1/2-quart portable decontaminating apparatus. DS2 can be applied with the M11 apparatus, brooms, brushes, or swabs. The solution is effective at temperatures from -27° C to 53° C (-15° F to 125° F).

- DS2 reacts with nerve agents (GA, GB, GD, and VX) and blister agents (HD, HL, L) to reduce their hazard effectively within 5 minutes after application. With sufficient contact time (up to 30 minutes) it is effective against all known war chemical agents. DS2 can be applied by scrubbing with a stiff bristle brush.

- Cautions for DS2 use. It is not corrosive to most metals, but corrodes aluminum, cadmium, tin, and zinc after prolonged contact. It removes and softens new paint, and may discolor old paint. It will soften leather and damage woolen fabric. Although DS2 can be used on some plastics and rubber, it should not be used on any item containing polycarbonates such as crash helmets and aircraft canopies. DS2 should not be used to decontaminate the protective masks because of possible damage to the mylar diaphragm in the voicemitter assembly.

Decontaminating Apparatus, Portable: M13 DAP. The M13 is designed to dispense standard chemical agent decontaminating solution, DS2. The DAP consists of an accessory container, a disposable decontaminant container, a manual in-line pump, a hose, two want sections, and an attachable, disposable brush. A new brush will be issued each time a new decontaminant container is obtained. The M13 weighs no more than 60 pounds when filled with DS2. It is to be vehicle mounted, man-portable, manually operated, and easily maintained. It is designed to fit in the standard fuel/water can mounting bracket. According to current proposed changes to the basic of issue plan (BOIP) for the M11, the M13 DAP will replace the M11 on a one-for-one basis in all units except Armor units and in selected applications. The DAP will be used by crews of tactical vehicles and self-propelled/towed artillery for the removal of chemical agent contamination. The item will be issued on the basis of one DAP per tactical/combat vehicle, including construction equipment and crew served weapons larger than 60 caliber. Fielding is scheduled for September 1985.

Natural decontamination of biological agents. The use of the natural decontaminants, weather, water, earth and fire are effective against biological contaminants. Weathering is the simplest method of decontamination and should be used whenever practical. Elements of weather that are effective in decontamination include low humidity, rain and sunlight.

- The killing of microorganisms through dehydration and exposure to sunlight (ultraviolet rays) are the principal means by which weathering accomplishes decontamination. The germicidal effects of ultraviolet and infrared rays in sunlight will kill most biological agents within one day. The rate at which microorganisms dry out (dehydrate) depends upon the moisture content of the air. Although some biological agents (spores) are not affected by low humidity or periods of dry weather, it aids in reducing most types of biological contamination.

- Rainfall will wash many microorganisms from objects. The wetting of the terrain by rainfall may prevent the formation of secondary aerosols, however, it may cause the leaching of spores into soil. Washing or flushing a contaminated surface with water removes much of the biological agent. The runoff from this operation must be controlled carefully and treated as such. Soap added to water used in washing contaminated surfaces aids in removing the agent.

- Covering biological contamination with earth is an expedient method of decontamination and is normally used in the disposal of water items used in the decontamination process.

- Fire is a rapid, simple, and effective means of decontaminating biological agents. Burning must be handled with care to avoid creating a secondary aerosol hazard caused by thermal currents carrying the agent aloft.

Natural decontamination of chemical agents. Evaporation and decomposition of chemical agents are the principal means by which weather gradually accomplishes chemical decontamination. The time necessary for decontamination by weathering is called the persistency of the chemical agent. The persistency of an agent is difficult to predict. Lack of time, unfavorable weather conditions, or proximity of contamination to unprotected personnel may require a faster method of decontamination.

- Elements of weather that affect the persistency of chemical agents are temperature, wind, humidity, rain, and sunlight.

- High temperatures promote evaporation and hasten the dispersal of chemical agents in the air. The persistency of liquid chemical agents on the ground decreases as the temperature rises.

- Aeration aids in decontamination. High winds disperse the vapors of the chemical agents rapidly and dilute their concentration.

- Moisture tends to break down chemical agents, however, most chemical agents break down very slowly. Heavy rain or long duration aids in decontamination by removing chemical agents mechanically. A concentration of chemical agents may, however, build up in drainage areas creating a contamination hazard.

- Sandy soil will tend to absorb the agent and thus increase the persistency.

- The shortest persistency on the ground is on non-porous, hard, smooth surfaces such as paved roads.

- The amount and type of vegetation in a given area will affect persistency of chemical agent. Chemical agents tend to collect on vegetation increasing the contact hazard. Decontamination of vegetated areas is more difficult than on open areas.

- Earth is used to seal in contamination and as an absorbent for liquid contamination. A covering of about 10 centimeters (4 inches) of earth gives protection as long as the earth is not disturbed and the chemical agent is exposed. Earth used as a seal or cover becomes contaminated and must be treated as contaminated waste.

- Fire vaporizes or burns liquid chemical agents. Fire is a rapid, simple and effective means of decontaminating large quantities of chemical agents that might be encountered in disposal or demilitarization operations. Some chemical agents are combustible and upon burning are converted in relatively harmless products. Troops adjacent to the burning site must be warned of the impending action to avoid friendly casualties.

INDIVIDUAL SURVIVAL AND INDIVIDUAL SUSTAINMENT DECONTAMINATION

Individual Survival Decontamination. Every soldier in the Army is required to know how to decontaminate his or her skin when contaminated with a liquid chemical agent. Considerable cost has been invested to acquire individual decontamination kits per soldier and to develop training literature and programs to ensure this training is received.

Chemical

- If chemical agents contact your skin because you did not wear protective gear or it was damaged, you must take immediate action to decon yourself. This immediate action must be started within 1 minute of becoming contaminated because chemicals, especially nerve agents, are rapidly absorbed by the skin and can kill in minutes.

NONSTANDARD DECONTAMINANTS

SUMMARY OF COMERICAL PRODUCTS FOR USE AS FIELD EXPEDIENT DECONTAMINANTS

<u>PRODUCT</u>	<u>MIXTURE RATIO</u>	<u>TIME OF CONTACT WITH AGENT</u>	<u>EFFECTIVE ON</u>	<u>COMMENTS</u>
Caustic soda or lye (sodium hydroxide)	10% by weight (10 lbs. lye 90 lbs water)	5-15 minutes depending on substrate	G agents, Blood agents, ON—	Mixing process generated considerable heat; solution is highly corrosive to skin fabrics, non-ferrous metals
Household bleach (Sodium Hypochlorite 5%)	Full strength or dilute as needed; read label	5-15 minutes or longer depends on strength of solution	V agent Blister agents	Causes burns and destroys some fabrics full strength; read label, easily obtained good all around
HTH (swimming pool chlorine)	Not more than 1lb. HTH in 2 lbs. Water (30% solution)	5 minutes, more or less depending on concentration	V-nerve agents Blister agents	Very corrosive to sprayers, metals, skin. Clean thoroughly after use
Household amonia (Amonium hydroxide 5%)	Full strength	5-25 minutes or longer	G agents	Special amonia mask needed slow acting, use if lye not available
Washing soda (Sodium carbonate) and Baking soda (Sodium bicarbonate)	10% solution - 10 lbs. soda to 12 gallons of water	5-30 minutes if possible use as a laundry agent	G agents, ON	Good for fabrics best way to decon ON

Line (Calcium oxide)	As much as will dissolve in water or sprinkle on dry	Use slurry as a wash or rinse solution	G agents	Weak decon- taminant, better than plain water but not much
GUNK	Full strength	Use as a solvent on oil, grease etc., where water doesn't help	All	Holds agent in solution until natural forces decon it; use decon on solution
Hot soap water (any soap or detergent)	See label or as needed	As long as possible	All skin exposures Nerve agents	Excellent for skin, clothing any unwieldy object or surface. Does little neutralizing, but flushes agent away. Inexpensive.

- The M258A1 skin decon kit provides the best means of skin decon. Instruction for its use are on the outside of the kit. The kit can be used in a temperature range of 0° Celsius (32° Fahrenheit) to 43° Celsius (110° Fahrenheit). The solutions in the kit are caustic. Keep them out of eyes, wounds, or mouth. Use water to wash toxic agent or decon solution out of eyes or wounds and seek medical treatment. Familiarize yourself with the operating instructions for the kit. If you need to use it at night, you will not be able to read the instructions. Although you cannot see liquid contamination in the dark, you may suspect it and you should decon as a precautionary measure. The packets in the kit have identifying tabs so you can feel for them in the dark. (Packet #1 has a 1/4 x 1/4 inch tab on the top of the packet; whereas Packet #2 has no tab at all).

- If you do not have a skin decon kit, chemical contamination may be pinch-blotted from the skin with any cloth and the area flushed with water from your canteen. Pinch-blotting is better than rubbing because it does not spread the contamination. Soap, if available, should be used to wash the agent from the skin. In the field, washing with soap and water is the next best method for decontaminating toxic agents if M258A1 decon kits are not available.

TYPE	BEST START TIME*	DONE BY	TECHNIQUE	GAINS MADE
INDIVIDUAL	BEFORE 1	INDIVIDUAL	SKIN DECON	Keeps you alive

Personnel Decontamination Kit. The M258A1 Personnel Decontamination Kit is a recent modification of the M258 Skin Decontaminating Kit. It also is used in chemical decontamination. The M258A1 kit is easier to use and can be used to decontaminate the interior of the protective mask and the face, as well as other skin and limited equipment decontamination. For training, a modified version of the kit, called the M58A1 kit, is used. The training kit contains alcohol instead of decontaminants.

The M258A1 kit is enclosed in a rectangular, plastic container. Instructions for using the kit are on the front. A metal clip and strap are attached to the back of the container for fastening the kit to the D-ring of the protective mask carrier, or to some other location on the soldier's clothing. The lid snaps on and off. Inside are six metallic packets containing decontaminating solutions. The packets marked "1" contain a paper pad saturated with decontaminant. The packets marked "2" hold a dry paper pad and a nylon screen envelope containing three glass ampules. Before this metallic packet is opened for use, it is squeezed to break the glass ampules, which then saturate the decontaminating pad. This prepares the decontaminant for use. In the decontamination procedure, the skin is first wiped with the Number 1 pad and then with the Number 2 pad.

Decontaminating eyes, face, and other skin areas. If your eyes and face become contaminated, you must first obtain overhead cover before proceeding with decontamination procedures. It is imperative that nerve agents (or blister agents) in contact with the eyes or skin be neutralized or removed immediately if you are to avoid becoming a casualty.

Decontaminate the eyes

Step 1. Remove helmet and loosen cap on canteen. While under cover, take a deep breath and hold it. Remove your mask and hood.

Step 2. Looking upward, while continuing to hold your breath, flip open cap on canteen and flush your eye(s) repeatedly with generous amounts of water. If possible, tilt your head at an angle so as not to let the water run onto your face or clothing. If you are unable to keep your eye(s) open during the flushing process, use your uncontaminated fingers to lift the eyelids and complete the process.

NOTE

To flush right eye, tilt head back and slightly to the right
To flush left eye, tilt head back and slightly to the left

Step 3. Put on, reseal, clear, and check your mask. Secure canteen cap.

Decontaminate the face

Step 1. Open decontamination kit and remove one DECON 1 WIPE packet.

Step 2. Fold packet on solid line marked BEND and FOLD. Tear open quickly and remove moistened wipe.

Step 3. Decontaminate your hands.

Step 4. Take a deep breath and hold it, close your eyes, and lift hood and mask. Pull the hood and mask far enough away from the face so that you are able to touch your nose with the moistened wipe.

WARNING

Both DECON 1 and DECON 2 packets contain a poisonous and caustic solution which can permanently damage the eyes. DO NOT use pads on the eyes, mouth, or open wounds.

Step 5. With eyes closed, continue to hold your breath and using the same wipe used in steps 3 and 4, quickly wipe your face and neck. Make sure all facial indentations are wiped (around nose, ears, and chin).

Step 6. Continue holding your breath and quickly wipe the inside of the mask that touches your face.

Step 7. Drop the used wipe to the ground and put on, reseal, clear, and check your mask.

Step 8. Open decontamination kit and remove one DECON 2 WIPE packet. Crush inclosed glass ampules between thumb and fingers, or smash ampules with palm of hand.

Step 9. Fold packet on solid line marked CRUSH and BEND. Quickly tear open packet and remove moistened wipe. Let the crushed glass ampules fall to the ground.

Step 10. Repeat steps 3, 4, 5, and 6, above.

Step 11. Fasten hood and put on helmet.

Decontaminate other skin areas

Step 1. Open decontamination kit and remove one DECON 1 packet.

Step 2. Quickly remove moistened wipe from packet, retaining the empty packet.

CAUTION

Immediately remove any liquid or thickened contamination. If large droplets or thick liquid agent appear on the skin, use the edge of the empty packet and carefully scrape off the agent. Let the packet drop to the ground.

Step 3. Using the wipe from the packet, pinch droplets from the skin and wipe area carefully for 1 minute. Drop used wipe to the ground.

Step 4. Open decontamination kit and remove one DECON 2 packet. Crush inclosed glass ampules between thumb and fingers or smash with palm of hand.

Step 5. Fold packet on solid line marked CRUSH and BEND. Quickly tear open packet and remove moistened wipe. Let the crushed glass ampules fall to the ground.

Step 6. Thoroughly wipe the contaminated areas for 2 to 3 minutes. Drop used wipe to the ground.

CAUTION

All discarded wipes and discarded packets used to remove the chemical agent should either be buried or disposed of in such a way as to avoid further contamination. DO NOT BURN contaminated waste. The vapors are caustic and poison hazard.

Biological

- You will most likely not know when or where biological contamination exists. However, if you know or suspect toxins or other biological agents are present, remove the contamination with M258A1 towelettes using the same procedures for the chemical agent decon.

- No currently fielded means of detecting biological agents exists; you probably will not know immediately when you have become contaminated. Fortunately, most biological agents, even toxins, pose their primary threat through inhalation or ingestion. The skin is an effective barrier against most biological agents providing there are no cuts in the skin.

- The unit surgeon knows the types and normal levels of natural infection for the area of operations. The surgeon monitors these levels. If a given disease reaches a high level, the unit surgeon decides whether or not a deliberate biological attack has occurred. For those reasons, no decon is required immediately.

- The best biological defense is to take action before you are attacked. Keep immunizations up to date, observe basic sanitary precautions, and keep skin breaks covered. Treat minor cuts and abrasions by ordinary first aid measures. Iodine, Zephiran, or Merthiolate are suitable. Washing with soap and water removes nearly all biological agents from the skin. If possible, frequent showering or bathing lessens chances of infection and disease. A 1.5 percent sodium hypochlorite (household bleach) solution is also an effective biological decontaminant.

Individual Sustainment Decon Techniques. There are two individual sustainment decon techniques--personal wipedown and operator's spraydown.

These techniques do two things for you:

- Reduces the contamination hazards on you and the surfaces you touch to do your mission.

- Keeps contamination from seeping into your individual equipment as well as those surfaces you touch to do your mission.

TYPE	BEST START TIME*	DONE BY	TECHNIQUE	GAINS MADE
INDIVIDUAL SUSTAINMENT	WITHIN 15 MINUTES	INDIVIDUAL or crew	PERSONNEL WIPEDOWN ----- OPERATOR'S SPRAYDOWN	Stop agent from penetrating

- Individual sustainment techniques are most effective when done within 15 minutes after being contaminated. Starting these techniques later is not as effective; contamination -- especially chemical agents -- will have begun soaking into equipment and will be little affected by these techniques. By reducing the contamination hazards on yourself and in your immediate work area you reduce the chance of your skin touching chemical or biological contamination if you tear a glove or rip a sleeve.

Personal Wipedown

The protective overgarment is designed to provide at least 6 hours of protection after becoming contaminated with chemical agents. However, the MOPP gear and handgrips of individual weapons also tend to absorb these chemicals. Once absorbed, they may present a vapor hazard for days. To reduce this penetration and vapor hazard, decon individual equipment using towelettes from the M258A1 kit. The individual equipment you must decon includes:

- Gloves
- Hood and Mask
- Weapon
- Helmet

Do not attempt to decon chemical agents on your overgarment. This will provide little if any extra protection and you probably will not have enough M258A1 towelettes to decon your suit.

When using the M258A1 personal decon kit on the protective mask-lenses, reverse the order of the decon wipe. Use decon wipe 2 first, followed by decon wipe 1. This technique is just as effective but does not leave a powdery film on the outserts (lenses). Decon wipe 1 is primarily effective against G-type nerve agents. Its contents are caustic to the skin, but leave no film when dry. Decon 2 is primarily effective against VX-type nerve agents and blister agents. Its contents are less caustic to the skin; in fact, they may help neutralize some of the caustic compounds in decon wipe 1. When M258A1 towelettes are not available, field expedient methods such as washing with soap and water are also effective.

Operator's Spraydown. After you have wiped yourself down and your personal equipment, you must continue your mission. This will frequently involve operating a vehicle, a crew-served weapon, or some other piece of equipment. To ensure that you do not pick up contamination from these items, you must decon those surfaces you or your crew touch while operating the equipment. This decon is called the operator's spraydown.

Chemical. Decon those surfaces you must touch to do your job. Use an onboard portable decon apparatus (such as M11 or M13). This apparatus should be filled with decontaminant as soon as you are directed to go into any level of mission-oriented protective posture (MOPP). Spray DS2 onto those surfaces you must touch to do your mission. Scrub the DS2 into the surface with brushes, wait 30 minutes if mission permits, then wash or wipe off. If the decon apparatus is not available, use decontaminating solution No. 2 (DS2) or super tropical bleach (STB) applied from bulk containers, or use the nonstandard decontaminants.

Biological. Hot, soapy water is the preferred decontaminant for biological contamination. Apply with brushes and scrub the surface well. Rinse surface after scrubbing. DS2 or STB are also effective against most known biological contamination; but because of their caustic nature are not preferred.

The ABC-M11 Decontaminating Apparatus, which will be called the M11 apparatus, is used in performing partial decontamination of vehicles and crew-served weapons contaminated by chemical agents. The M11 apparatus resembles a carbon dioxide fire extinguisher. It has a canister that is filled with 1 1/3 quarts of DS2 decontaminating agent which is released, under pressure, as a spray. To understand the function of the M11 apparatus, you must be able to describe its purpose, capabilities, limitations, and components. You also need to understand the characteristics of Decontamination Solution 2, called DS2.

NOTE

The protective mask and gloves should be worn when handling DS2 while filling the apparatus.

The MII apparatus is used to partially decontaminate vehicles and crew-served weapons, such as trucks, tanks, armored personnel carriers, howitzers, self-propelled artillery, and machine guns. It is used to decontaminate parts such as the steering wheel, gearshift lever, seats, pedals, dashboard, levers, gasoline caps, and tools. The apparatus is carried on vehicles and is held in place by a mounting bracket. It is used to spray surfaces that might be contacted by persons entering, leaving, operating, servicing, or repairing the vehicle.

The MII apparatus is not intended for total decontamination. Rather, it is used to decontaminate those parts of vehicles and equipment that the operator might touch.

Capabilities

The decontamination capabilities of the MII apparatus are as follows:

- It covers approximately 135 square feet with one filling of the canister.
- It sprays up to a range of 6 to 8 feet.
- It operates in temperatures as low as -25° F (-31° C).
- It can be used by an individual with limited training.

One filling of the MII apparatus is sufficient for the partial decontamination of the steering wheel, gearshift lever, pedals, and dashboard of two 1/4-ton trucks.

Limitations

The limitations of the MII apparatus are as follows:

- The apparatus must not be used to decontaminate individuals, because the DS2 blisters skin and can cause blindness.

- A protective mask and gloves must be worn by personnel handling or using the apparatus when filled with DS2.

- The MII apparatus will not be used to spray hot surfaces, such as hot engines. DS2 is a combustible liquid with a flash point of 175° F (79.5° C).

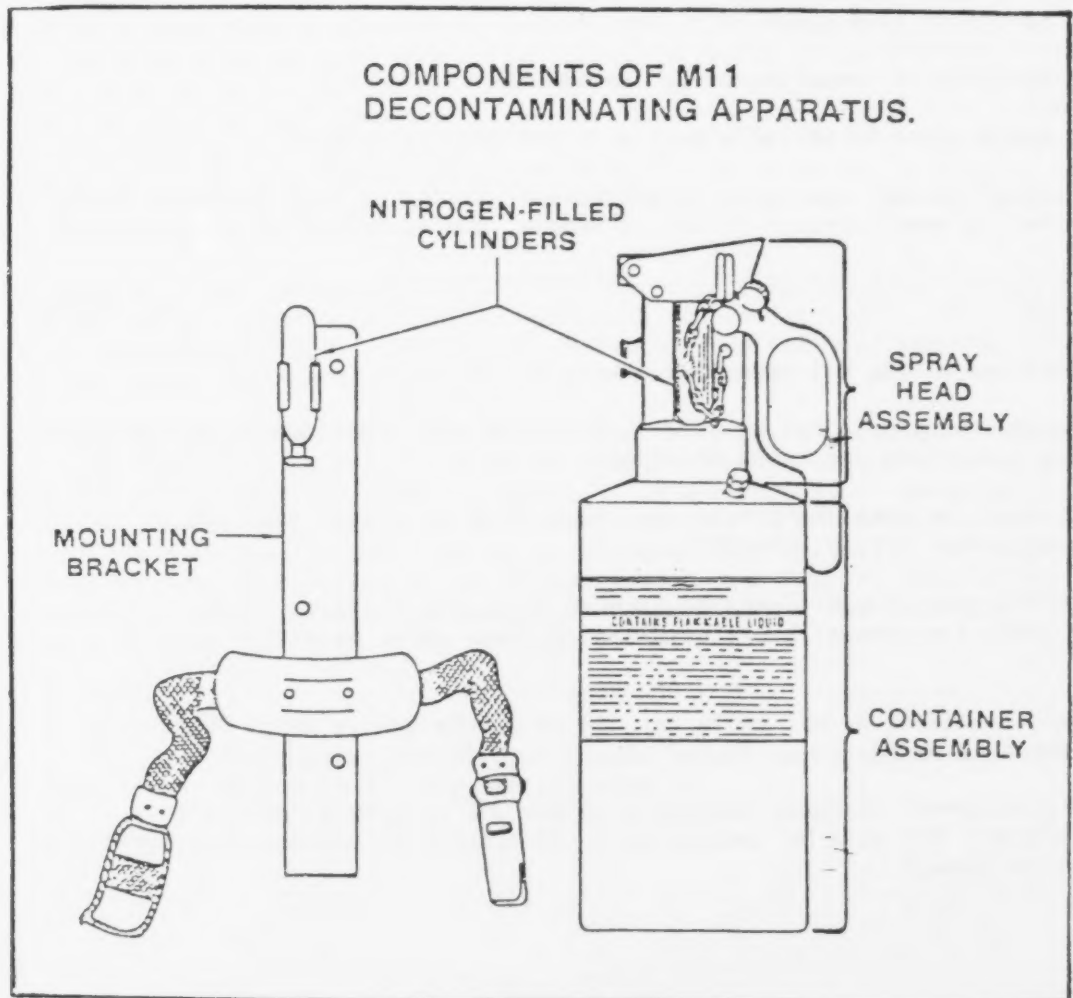
- The contents of a full container can be discharged in about 30 seconds of continuous spraying.

- Only equipment surfaces sprayed with the DS2 will be effectively decontaminated. DS2 must be removed after 30 minutes of contact to prevent corrosion and damage.

Description of the M11 Apparatus

The mounting bracket and hardware are used to hold the M11 apparatus in place in a vehicle. There are two types of mounting brackets. The older model uses a metal strap to hold the container. The newer model uses a nylon strap. The spray head assembly is attached to the container assembly, which is filled with DS2 decontaminating agent. One of the nitrogen-filled cylinder is mounted in the spray head assembly; the other cylinder is attached to the mounting bracket. The nameplate is attached to the container. Two types of nameplates have been used. One type is a metal band which circles the apparatus and is secured with a metal clasp. The other type is an aluminum foil type with adhesive backing. Both types provide essentially the same information.

The spray head assembly can be unscrewed from the container assembly in order to refill the container with DS2. In addition, the nitrogen cylinder in the spray head assembly can be removed and replaced after each use of the M11 apparatus.



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Operate the ABC-MII Decontaminating Apparatus

To operate the MII apparatus correctly, you must be able to:

- Prepare the MII apparatus for operation.
- Fill the apparatus
- Install a nitrogen cylinder in the apparatus.
- Install a safety seal wire.
- Pressurize the apparatus.
- Operate the apparatus.
- Operate the apparatus in training.

Prepare the MII Apparatus for Operation. To prepare the MII apparatus for operation you should perform the following steps:

Step 1. Remove the apparatus from the mounting bracket.

Step 2. Check that the apparatus has been filled with DS2. If it has not been filled, perform the steps for filling it.

Step 3. Check that a nitrogen-filled cylinder is in place in the spray head assembly. If it is not, perform the steps for installing a new nitrogen cylinder.

Step 4. Check that the safety seal wire is not broken. If it has been broken, proceed to the steps for filling the apparatus.

Step 5. If all checks are okay, proceed to pressurize the apparatus.

WARNING

The protective mask and gloves should be worn when handling DS2 while filling the apparatus.

Fill the Apparatus. To fill the apparatus, perform the following steps:

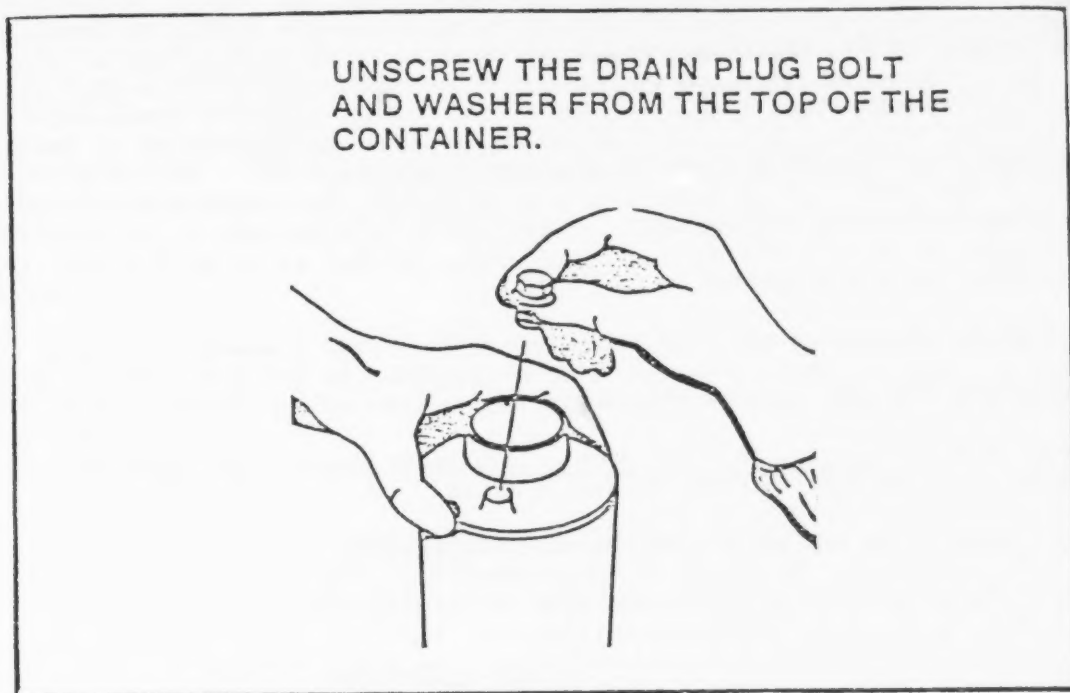
Step 1. Check that the safety seal wire is unbroken.

NOTE

If the safety seal wire has been broken, the apparatus may have been pressurized. If so, any remaining pressure must be emptied by operating the apparatus.

Step 2. Unscrew the spray head from the container.

Step 3. Unscrew the drain plug bolt and washer from the top of the container.



Step 4. Empty the container in an area designated as safe by the unit commander.

Step 5. Invert the container and lightly tap it against another object to remove any foreign material from inside the container.

Step 6. Reinstall the drain plug bolt and washer using light pressure on a small wrench to make a tight joint without damaging the copper washer.

Step 7. Pour contents of a 1 1/3-quart can of DS2 into the container through the opening in the top.

NOTE

If filling from a larger container, pour in DS2 to the level of the yellow line on the container marked FULL LINE. The end of the container neck inside the container body should be used as guide since it is at the same level as the yellow fill line.

Step 8. Ensure that the preformed packing in the neck of the container is in good condition.

Step 9. Screw the spray head firmly into the opening in the container.

Install a Nitrogen Cylinder in the ABC-MII Apparatus. To be able to install a nitrogen cylinder in the ABC-MII apparatus you must know the following steps:

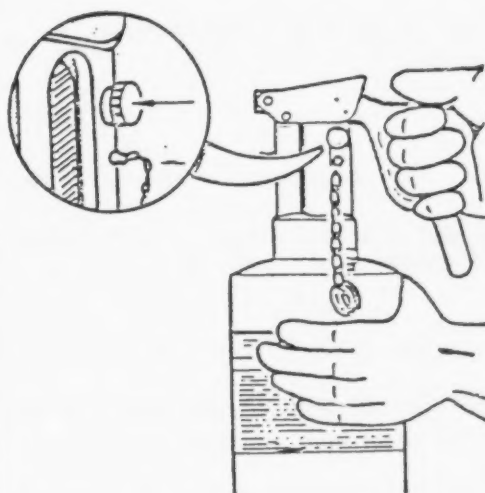
Step 1. Remove the captive safety pin.

Step 2. Push in a handle locking pin (see insert) and lower the handle.

PREPARE TO INSTALL NITROGEN
CYLINDER.



A
REMOVE THE
CAPTIVE SAFETY PIN



B
LOWER THE HANDLE

Step 4. Discard the old cylinder.

Step 5. Ensure that the performed packing between the spray head and nitrogen cylinder is in good condition.

Step 6. Ensure that the opening for the nitrogen-filled cylinder is clean and free of foreign matter.

WARNING

Place the handle in the lowered position before installing the nitrogen-filled cylinder to prevent premature puncturing of the cylinder and its expulsion from the spray head assembly.

NOTE

Use care when inserting a new nitrogen-filled cylinder into the spray head to avoid cutting the preformed packing.

Step 7. Raise the thumb lever and insert a new nitrogen-filled cylinder, small end down, in the opening in the spray head. The cylinder neck must engage the preformed packing.

Step 8. Release the thumb lever.

Step 9. Install the captive safety pin.

Install Safety Seal Wire. To install the safety seal wire the following steps should be used:

NOTE

If the apparatus has not been filled, install a safety seal wire.

Step 1. Thread a safety seal wire through the hole in the handle, through the hole in the handle pivot pin, and through the pull ring of the captive safety pin.

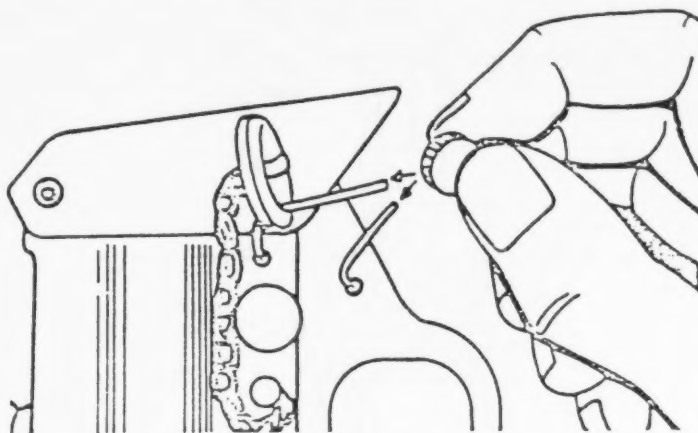
Step 2. Pass the wire through the hole in the lead disk two times.

Step 3. Pull the wire tight so that the captive safety pin cannot be pulled from the spray head body without breaking the wire.

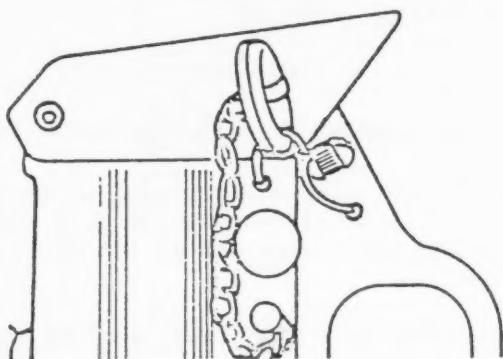
Step 4. Crimp the lead disk so that the wire cannot be pulled from the holes in the lead disk. This will ensure that the wire will break when the captive safety pin is withdrawn.

Step 5. Trim off excess safety wire, if desired.

THREAD THE SAFETY SEAL WIRE.



CRIMP THE LEAD DISK.



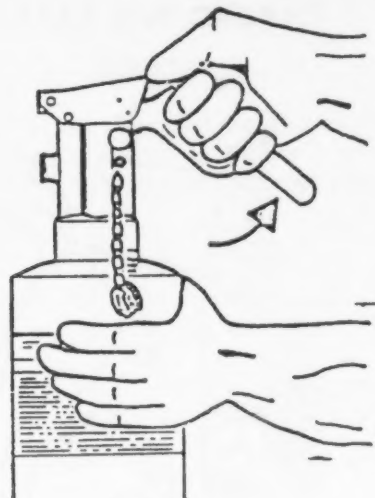
Pressurize the Apparatus. To pressurize the apparatus, use the following steps:

Step 1. Withdraw the captive safety pin. This will break the safety seal wire.

Step 2. Rest the container on a solid surface.

Step 3. Slowly raise the handle until the locking pin springs out and locks the handle in place. When the handle is raised, the nitrogen-filled cylinder is punctured, and the container is pressurized.

RAISE THE HANDLE.



CAUTION

Never initially pressurize the container with more than one nitrogen-filled cylinder.

WARNING

Do NOT use the apparatus if the container is damaged.

Do NOT use DS2 decontamination agent to decontaminate personnel. It is irritating to the skin and eyes. If DS2 decontaminating agent does get on the skin, blot it off, and rinse with water.

Wear a protective mask and gloves when using the apparatus to decontaminate.

Do NOT use the apparatus as a fire extinguisher, it contains combustible liquid.

Operate the Apparatus. The procedures for operating the apparatus are as follows:

Step 1. Spray decontaminating agent by depressing the thumb lever. Hold the apparatus upright so that as much liquid as possible is forced from the container.

**SPRAY THE DECONTAMINATING
AGENT.**



NOTE

Spray the parts of the vehicles that are most likely to be touched or used, such as door handles, steering wheels, controls, seats, dashboard, levers, gasoline caps, and tools.

Remember that the contents of one full container can be discharged in about 30 seconds of continuous spraying time.

Step 2. After the first nitrogen-filled cylinder is expended, shake the container to determine whether it is empty. Use a second nitrogen-filled cylinder to expel any remaining contents.

NOTE

In cold weather, more than one nitrogen-filled cylinder may be required to completely empty the contents of the apparatus.

Place the handle in a lowered position before installing the nitrogen-filled cylinder to prevent premature puncturing of the cylinder and its expulsion out of the spray head assembly.

Step 3. To use the spare nitrogen-filled cylinder depress the handle locking pin and lower the handle (refer to steps for installing a nitrogen-filled cylinder).

Step 4. Raise the thumb lever and push the expended cylinder out of the spray head body. Discard it.

Step 5. Insert the spare nitrogen-filled cylinder in the spray head body, neck down.

Step 6. Release the thumb lever and repressurize the apparatus (refer to the steps for pressurizing the apparatus).

Step 7. When the charge is expended, depress the handle locking pin and lower the handle.

Step 8. If you have completed spraying, reinstall the captive safety pin and replace the apparatus in the mounting bracket. If not, repeat the procedure for filling and installing a new nitrogen-filled cylinder, and for pressurizing and operating the apparatus.

Step 9. Whenever possible, those items that have been sprayed with DS2 should be rinsed with water. Rinsing should not be done until at least 30 minutes after spraying.

WARNING

The apparatus may be used in training exercises. However, do NOT use DS2 with the apparatus in such exercise.

Operate the Apparatus in Training. To operate the apparatus in training use the following steps:

Step 1. To use the apparatus for training, add 0.5 ounces of corrosion inhibitor to the empty container.

Step 2. Fill the container to the yellow fill-line with water, and assemble the spray head to the container.

Step 3. Operate according to usual operating procedures.

Step 4. After use, clean the apparatus.

Step 5. Remove the corrosion-inhibitor mixture from the apparatus by thoroughly flushing the spray head assembly and container with a mixture of water and commercial detergent.

Step 6. Rinse the apparatus with clean, preferably hot, water.

Step 7. Remove the rinse water from the container and the spray head assembly with compressed, dry air. Depress the thumb lever and direct the compressed air through the siphon tube to remove the water solution from the valve mechanism.

DECONTAMINATE EQUIPMENT USING THE ABC-MII DECONTAMINATION APPARATUS

CONDITIONS

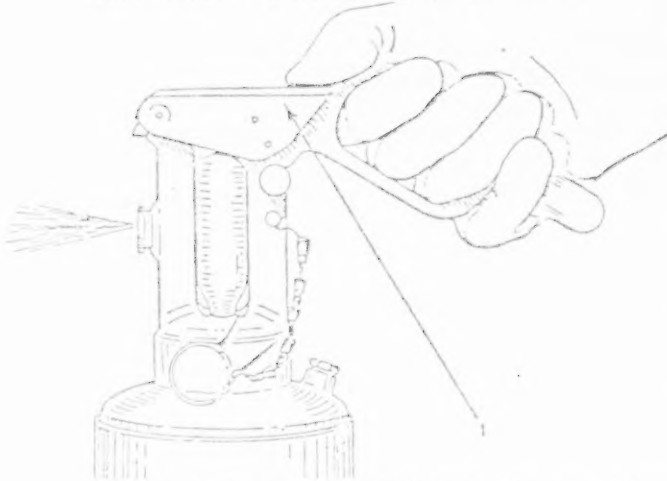
In a training environment where you are wearing protective clothing and protective mask and given either a vehicle or equipment contaminated with (simulated) chemical agents, an ABC-MII decontamination apparatus filled with enough liquid (i.e., water/corrosion-inhibitor solution or antifreeze) to decontaminate the parts of the vehicle or equipment which you touch when you use it, a nitrogen cylinder, a full can of liquid to simulate a 1-1/3 quart can of DS2 decontaminating liquid, and an adjustable wrench.

STANDARDS

All procedures for the decontamination of equipment with the ABC-MII decontamination apparatus are performed, in proper sequence, without contaminating your skin, the ABC-MII decontamination apparatus is refilled.

PERFORMANCE MEASURES

- Open the clamp and remove the ABC-MII.
- Pull out the pin (2). This will break the wire (3). See Figure 1.
- Put the ABC-MII on a solid surface (1). ~~tr~~Slowly raise the handle (2) until the pin (3) springs out and locks the handle. ~~en~~See Figure 2. ~~aratus~~.
- Hold the ABC-MII by the handle. Point it ~~itowherenyoufwantitotspray~~. ~~t~~Press down the lever (1) with your thumb. See Figure 3. ~~pr~~Warning: ~~pu~~DS2 is highly ~~he~~corrosive. Do not spray on personnel. ~~of the spray head assembly~~.



linder depress the handle locking
installing a nitrogen-filled

expanded cylinder out of the spray

linder in the spray head body,

urize the apparatus (refer to the

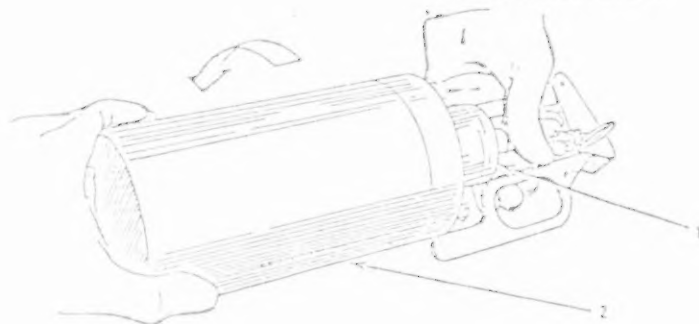
s the handle locking pin and lower

- Spray the liquid over the parts you touch when using the vehicle decontaminating equipment. ~~install the captive safety pin and~~
~~lled cylinder, and for~~

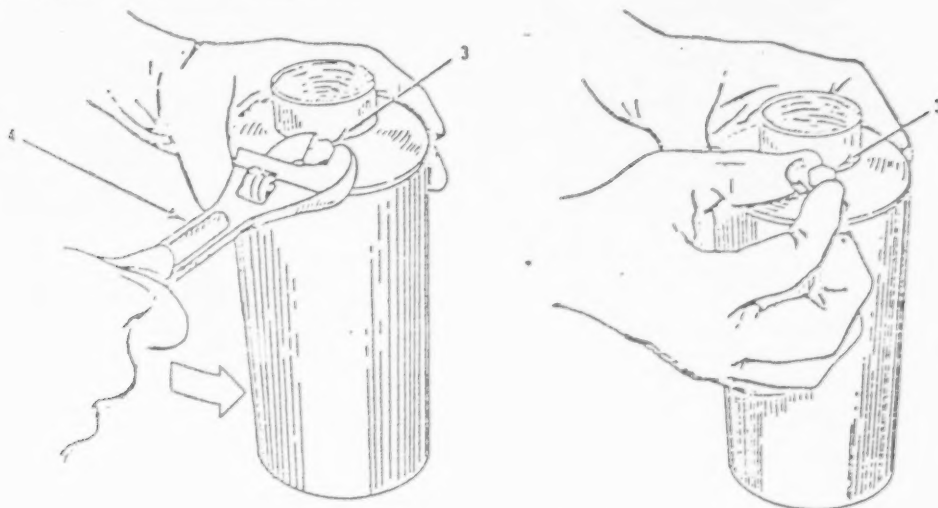
- Wait 30 minutes and rinse the liquid off with water, if you can. ~~have been sprayed with DS2 should~~
Refill the ABC-MII with decontaminating liquid (DS2). ~~at least 30 minutes~~

- Unscrew the ABC-MII top. Hold top (1) in left hand and bottom (2) in right hand. Turn as shown in Figure 4.

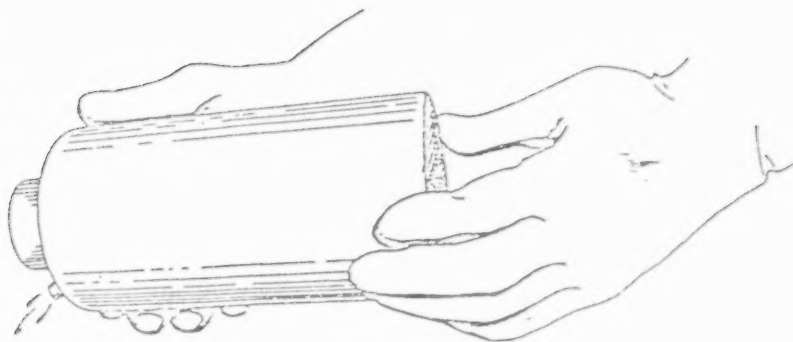
raining exercises. However, do
in such exercise.



b. Loosen plug (3) with a wrench (4) as shown in figure 5. Take out the plug and washer (3) with fingers.



c. Turn the ABC-MII upside down. Empty container.



d. Screw the plug and washer back in. Tighten with the wrench. Make a good seal but do not crush the washer.

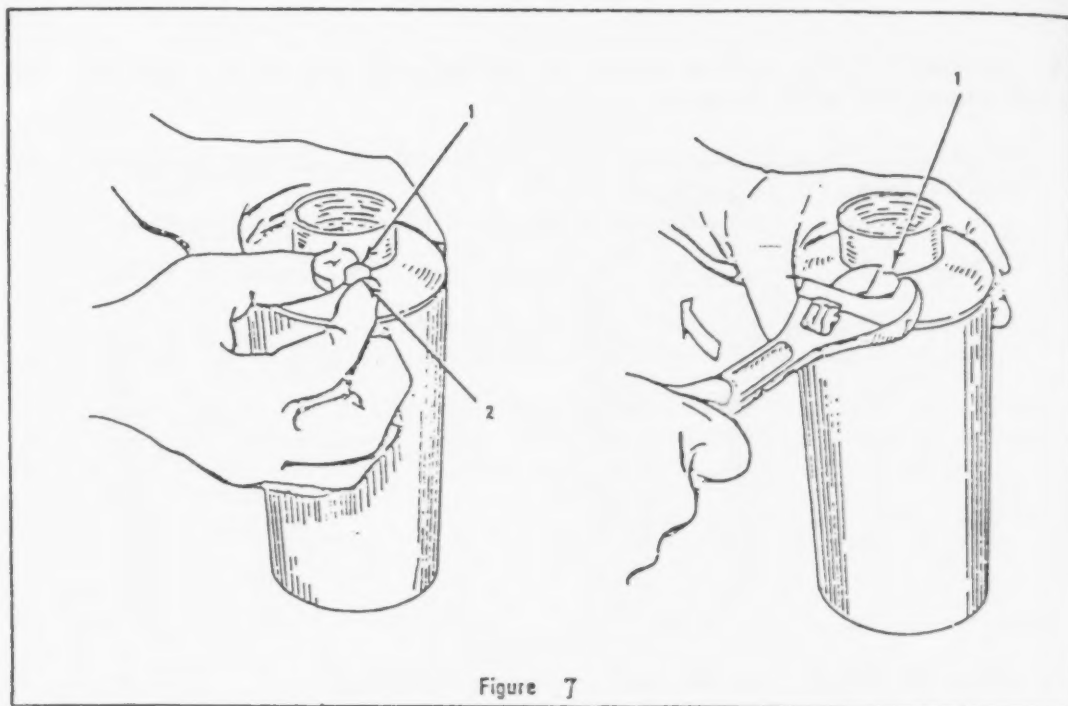
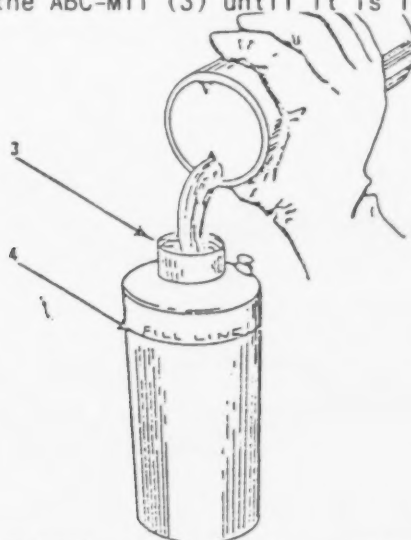
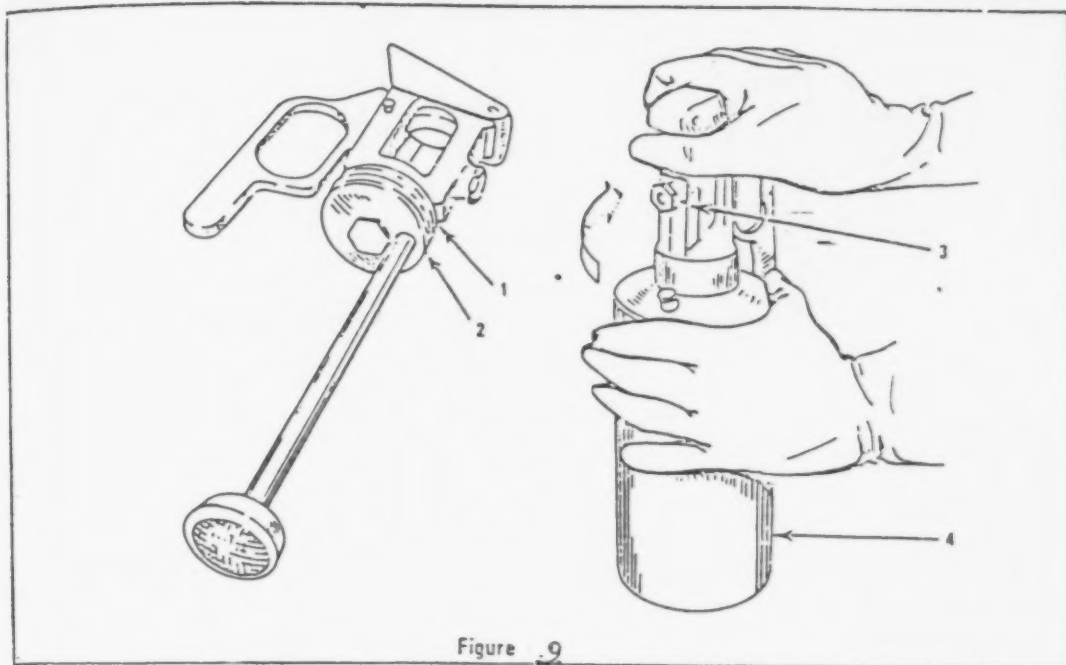


Figure 7

e. Pour DS2 into the ABC-MII (3) until it is level with the fill line (4).

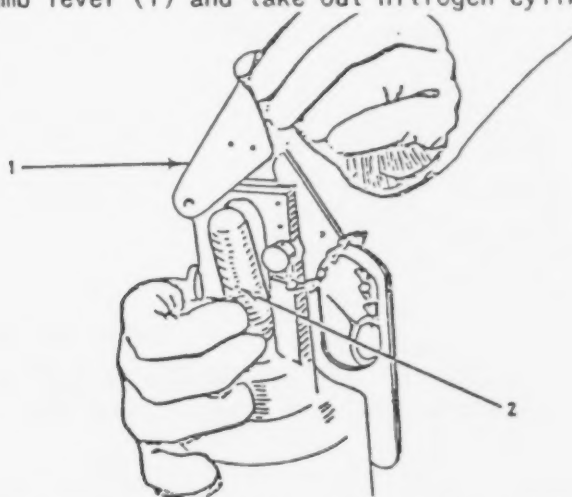


f. Look at the sprayhead. See that the packing (1) and threads (2) are okay. Screw sprayhead (3) back into the ABC-MII (4).



Put in nitrogen cylinder.

Lift up thumb lever (1) and take out nitrogen cylinder (2).



b. Look into cylinder hole (5). See that it is clean.

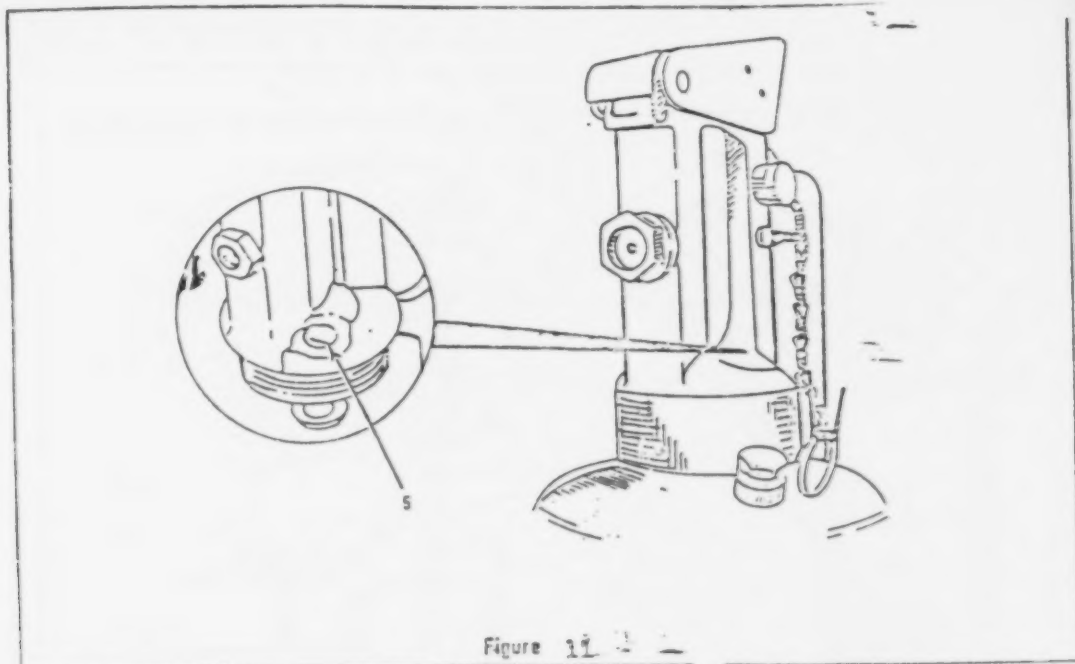


Figure 11

c. Lift up thumb lever (1) and put in nitrogen cylinder (2). Make sure the small end (3) fits into the cylinder hole.

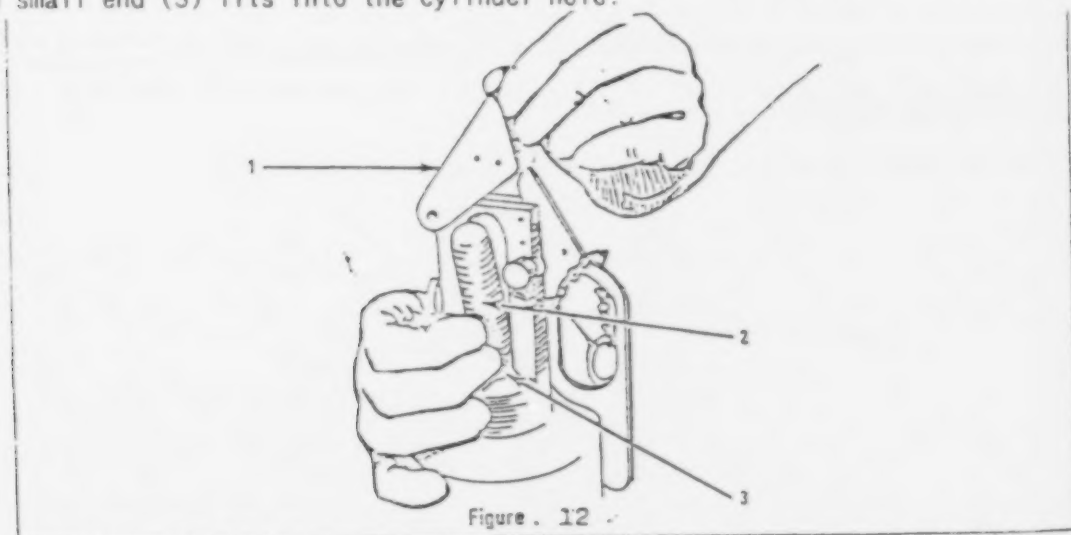


Figure 12

d. If you are not going to use it, tell maintenance to put in a safety wire. Then put the ABC-MII in bracket (4) and clamp it down (5).

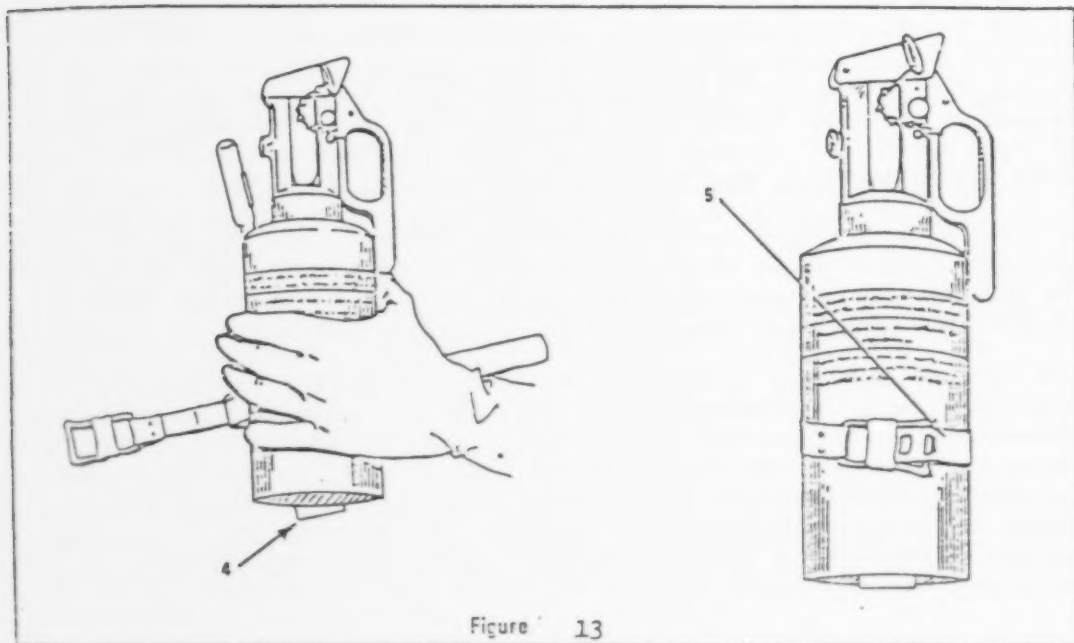


Figure 13

REFERENCES

FM 21-3, Task 031-503-2002

UNIT SUSTAINMENT DECONTAMINATION

Unit sustainment decon is a squad-size (occasionally platoon-sized) operation that consists of two techniques, the MOPP gear exchange and the vehicle washdown. The MOPP gear exchange is conducted by the contaminated squad and supported by the company supply section which provides decontaminants and new overgarments. The vehicle washdown is supported by the battalion level decon team using their organic power driven decontamination equipment (PDDE) or even supported by a chemical company decon squad.

The purpose of unit sustainment decon is to sustain the combat potential of a contaminated force by limiting the spread of contamination. The benefits gained from limiting contamination spread may allow temporary MOPP reduction. The MOPP gear exchange removes nearly all liquid or solid contamination from the soldier and his individual equipment. The vehicle washdown greatly reduces the transfer hazard on equipment. After unit sustainment decon, soldiers may be able to move away from their equipment to contamination free areas and temporarily reduce MOPP levels.

Unit sustainment should be done as soon as possible. A squad can do both of the techniques in about 30-45 minutes as it moves between fighting positions. The vehicle washdown portion is most effective if started within one hour of becoming contaminated.

Chemical contamination is the most difficult to remove and is usually the most dangerous form of contamination. This lesson focuses on the decon of chemical contamination. The procedures that reduce chemical contamination also reduce biological contamination and remove some radiological contamination. However, the caustic decontaminants used to remove chemical contamination are not needed to reduce the hazards of other kinds of contamination. Therefore, changes in methods and materials will be noted where they will improve the technique when it is used to decon biological and radiological contamination.

TYPE		BEST START TIME	DONE BY	TECHNIQUE	GAINS MADE
UNIT SUSTAINMENT	WITHIN 6 hours	Co. decon tm w/FFE, Bn PDDE Crew, or Chem Co	MOPP GEAR EXCHANGE VEHICLE WASHDOWN		Possible Temporary re- lief from MOPP 4. Limit liquid agent spread

CONDUCT VEHICLE WASHDOWN

CONDITIONS

Given a situation with a vehicle contaminated with a simulated chemical agent, all necessary materials, and a directive to conduct a vehicle washdown.

STANDARDS

The student will correctly answer 8 out of 10 questions.

PERFORMANCE MEASURES

- All vehicle/equipment is buttoned up. All access doors, hatches, windows, and other openings are secured prior to washdown. Muzzle covers are placed on all weapons.

- Vehicle/equipment washdown is conducted without washing or splashing into uncontaminated areas. The top and undercarriage of all vehicles are completely washed down.

- Personnel. Two soldiers from the battalion decon crew are used to wash down equipment, a third soldier supervises this operation and assists as necessary.

- Material.

- One PDDE.

- Liquid detergent to mix in water.

- Adequate water supply (about 100 gallons per vehicle required).

- Adequate fuel for water heater and pump unit.

REFERENCE

FM 3-5

VEHICLE WASHDOWN

Vehicle washdown is just that. It is a very simple process of washing your vehicle to prevent the spread of contamination and to reduce that hazard from NBC contamination. FM 3-5 tells us that this procedure is done by the battalion decon team using their power-driven decon equipment and hot, soapy water.

Vehicle washdown is supported by battalion. Decon operations are conducted as far forward as possible.

Vehicle washdown is most effective if started within one hour after becoming contaminated with each vehicle washed with hot, soapy water for two or three minutes.

Because speed is important and detection is difficult, vehicles are not checked for chemical contamination after vehicle washdown is completed. Only gross contamination is removed. As a result, most partially decontaminated equipment will still remain a hazard caused by vapors that are absorbed from the liquid chemical agent remaining in the paint. The chart below demonstrates the persistency of blister agent (HD) on painted surfaces with and without decontamination.

CARC Chemical Agent Resistant Coating, a polyurethane base paint now being applied to some new equipment.

Persistency of blister agent (HD) at 65° (18°C) with and without decon.

CARC surface
decon with DS2

CARC surface
weathering only

Alkyd surface
decon with DS2

Alkyd surface
weathering only

01 6 12 18 24 30 36 42 48 54 60 66 72 78

Time at which decon starts

Vapor or desorption hazard

Liquid agent transfer hazard

Chart based on initial liquid agent concentration of 10 grams per square meter. This is based on laboratory data and does not consider the affects of agent action on unpainted surfaces, agent seeping into cracks or under bolt heads, which would lengthen the persistency of contamination on actual equipment in the field. Lower temperatures would also lengthen times.

Step 1. Vehicle/equipment button up. The purpose of this step is to prevent contamination from being washed or splashed into uncontaminated areas. Close and secure all access doors, hatches, windows and other openings prior to washdown. Emplace muzzle covers on weapons. This will be performed by equipment crew/operators.

Step 2. Vehicle/equipment washdown. The purpose of this is to limit spread of contamination, minimize the hazard, and make detailed equipment decon easier and faster. Hot, soapy water is sprayed under pressure from the PDDE onto equipment surfaces to destroy, neutralize, or remove most of the NBC hazards. Unheated, soapy water or plain water may be used if the situation dictates; however, it is less effective than hot, soapy water. Ensure the tops of vehicles are washed down.

Personnel and Material Requirements

Personnel. Two soldiers from the battalion decon crew, wash down equipment. Tap aprons or wet weather gear are required to be worn over MOPP gear to keep from saturating the overgarment. One additional soldier is required to supervise the operation and assist as necessary.

Material.

- One PDDE.
- Liquid detergent to mix in water.
- Adequate fuel for water heater and pump unit.

UNIT RESTORATION DECONTAMINATION

There are seven standard decon techniques that progressively help restore combat potential. Each method becomes progressively more costly in terms of manpower, materials, and time. The most critical of expenses in most tactical situations will be the time element involved in the decontamination process. Reviewing the four decon principles, demonstrates the criticality of time, e.g., decon as soon as possible, decon as far forward as possible, decon only what is necessary, and decon by priority. The decision to undergo complete decontamination is made when the contaminated unit is essentially combat ineffective, a replacement unit is available, or time is available to reconstitute the contaminated unit without replacement, and divisional decontamination and logistical assets are available to complete the mission.

Unit restoration decontamination is the most time and resource consuming decontamination process and uses two decontamination techniques: detailed troop decontamination and detailed equipment decontamination. Restoration decontamination is designed to return a contaminated unit back into fully outfitted ready-to-fight unit. Because this operation is so resource intensive, it is accomplished in the brigade, division, or in some cases, the corps rear area.

The operation is conducted in two phases: the decontamination phase and reconstitution phase. The decontamination phase is further broken down into preparation, execution, and site clearance. The reconstitution phase takes place after the unit decontaminates, and includes medical, logistical, maintenance, military police, and quartermaster support. The division chemical company (platoon can support two companies) is directly responsible for the detailed equipment decontamination process but only provides supervisory support for the detailed personnel decontamination operation.

TYPE	BEST START TIME	DONE BY	TECHNIQUE	GAINS MADE
UNIT RESTORATION	When mission allows reconsti- tution	Unit and Chem Co Decon Platoon	DETAILED TROOP DECON DETAILED EQUIP- MENT DECON	Probable long-term MOPP reduction with minimum risks

It is critical that coordination between the battalion, the chemical unit, and the contaminated unit is completed prior to execution of the operation. The decon platoon leader is in charge of the decontamination site and will provide a briefing of the operation to the decontaminated unit at the pre-decon site (staging/holding area). The decon platoon will require company assets to conduct the operation. These will be specified at the briefing, however, a unit must already have trained decontamination team to ensure success of the operation.

ESTABLISH DETAILED TROOP DECONTAMINATION OPERATION

CONDITIONS

Given a situation or sketch of a detailed troop decontamination operation, pencil and paper.

STANDARDS

The student will correctly list, in proper sequence, the stations for a detailed troop decontamination operation.

PERFORMANCE MEASURES

- STATION #1. Individual gear drop
- STATION #2. Overboot and hood decon
- STATION #3. Overgarment off (Removal)
- STATION #4. Overboots and gloves off (Removal)
- STATION #5. Monitor
- STATION #6. Mask removal
- STATION #7. Mask decon point
- STATION #8. Reissue point

REFERENCE

FM 3-5

DETAILED TROOP DECONTAMINATION OPERATION

The detailed troop decontamination technique resembles the personnel decontamination operation conducted for unit sustainment. The primary difference is that in detailed troop decontamination masks are removed, decontaminated, and reissued with a new hood and filters.

Unit restoration decontamination, as started before, is resource intensive. Manpower requirements for the contaminated unit include 13 personnel for the detailed troop decontamination site (five decon team members and eight non-decon team members) and 5 personnel for the detailed equipment decontamination site (three decon team members and two non-decon team members).

STATION #1. Individual gear drop. Remove as much contamination as possible from the individual equipment (load-bearing equipment, mask carrier, helmet, and weapons). Gear is deconned by washing and scrubbing with STB slurry and rinsed with clear water. Equipment is checked with M8 paper and the M256 chemical detection kit.

STATION #2. Overboot and hood decon. Neutralize gross contamination on footwear covers and lower trouser legs. Remove gross contamination from hood and mask. For chemical and biological contamination a shuffle pit with STB dry mix is used to kick decontaminant onto boots and lower trouser legs. Hoods are cutoff if replacement hoods are available; if not used the M258A1 skin decon kit to decontaminate hoods.

STATION #3. Overgarment-off. Remove contaminated overgarments before agent penetrates overgarment material and touches undergarments or skin.

STATION #4. Overboots and gloves-off. Remove contaminated overboots (footcovers) to limit the spread of contamination. There is a "hot line" marked on the ground at this station. It is control line beyond which there should be no liquid contamination.

STATION #5. Monitor. Identify contamination on personnel, provide spot decon capability, and provide medical aid as required.

STATION #6. Mask Removal. Remove the mask from the soldier without contamination, and then take the mask to a mask decon point. As the mask is removed, the soldier holds breath, walks upwind 5 meters, crosses the vapor hot line, then resumes breathing. No chemical vapor hazard is expected beyond this hazard contamination control line, if wind direction remains constant. The Automatic Chemical Agent Alarm will be positioned to warn of vapor hazards.

STATION # 7. Mask decon point. Remove as much contamination from the mask as possible. Mask will be contaminated and sanitized and filters removed.

STATION # 8. Reissue point. To refurbish the soldier with a complete set of MOPP gear. Individual will reassemble mask. Company chemical NCO will affix new MIOAI filter canisters to M24/M25AI protective masks. Individuals will pick-up individual equipment (load-bearing equipment, mask, carrier, helmet, and weapons).

Personnel required at each station. The detailed troop decontamination operation requires five company decon team members and eight non-decon team members.

Personnel

<u>STATION</u>	<u>ATTENDANT'S ACTION</u>	<u>CONTAMINATED</u>	<u>COMPANY</u>
		<u>Decon Team Members</u>	<u>Non Decon Team Members</u>
(1) Gear Drop/Decon	One person monitors and one person transports individual gear to reissue point.	0	2
(2) Boot/Hood Decon	Attendant replenishes decontaminants as required..	1	0
(3) Remove Suit	None (Buddy System)	0	0

(4) Remove Boots and gloves	None (Buddy System) Attendant from station 6 will meet personnel wearing M24/M25A1 mask to carry canister until person's mask is removed at station 6.	0	0
(5) Monitor	Attendant checks for decon effectiveness. Medic treats as required.	1 —	1*
(6) Remove mask	Attendant removes mask and transports to station 7.	0	2
(7) Mask Decon Point	Attendant disassembles, clears, checks, and transports mask to station 8.	2	1
(8) Reissue Point	Chemical NCO and Supply Sergeant man this station	0	2**
Sub Total		4	8
Co Decon Team Chief		1	
Total		5	8

Materials required at each station.

STATION #1. Individual gear drop.

- For all form of contamination:

- Two 30 gallon containers (one for decontaminants, one for rinse).
- Two long-handled brushes (to scrub equipment).
- Water (for rinse).

-For chemical and biological contamination:

- Decontaminant (STB slurry).
- M8 detector paper and M256 chemical detection kit (for contamination check).

STATION #2. Overboot and hood decon.

- For all types of contamination:
 - Cutting tool to remove hoods.
- For chemical and biological:
 - Ten drums of STB for shuffle pit.
 - One each M258AI decon kit per person.

STATION #3. Overgarments-off. Two containers.

STATION #4. Overboots and gloves-off.

- Cutting tool (to remove overboots).
- Draw a line on the ground or use enigneur tape as a hot line to separate the "dirty" from "clean" areas. Exception to this clean area will be the dirty gloves. However, no liquid agent should be tracked along the ground after the hot line.
- Two containers (one on dirty side of line for overboots, one on clean side for gloves).

STATION #5. Monitor.

- For all types of contamination:
 - First aid supplies, including agent antidotes for the medics use.
- For chemical/biological contamination:
 - M8 paper.
 - Skin decon kits.

STATION #6. Mask removal. No materials required.

STATION #7. Mask decon point.

- Container to discard filter elements and other refuse.
- Hot soapy water (for wash).
- Sanitizing solution.
- Water for mask rinse.

- Four sponges.
- One case of paper towels to dry mask during refit process.

STATION #8. Reissue point. None for station operation. However, all personnel leaving reissue point should have with them one complete set of MOPP gear prior to arrival in assembly area. Individuals should also have all required components for their masks. A second set of MOPP gear for every assigned individual must be available in the company. Resupply is necessary so that each soldier has two sets of MOPP gear--one with him/her and one stored by his/her company.

SUPERVISE A DETAILED TROOP CONTAMINATION OPERATION

CONDITIONS

Given a written situation that requires the supervision of a detailed troop decontamination operation, pencil, and paper.

STANDARDS

The student will correctly answer 8 of the 10 questions.

PERFORMANCE MEASURES

- Ensures a logical flow of buddy teams through decontamination stations. (A planning chart such as the one on the next page is used to monitor the times each buddy team remains at each station.)

- Ensures the correct decontamination techniques are used at each station.

- Ensures proper sequence as depicted below.

STATION #1. Individual gear drop

STATION #2. Overboot and hood decon

STATION #3. Overgarment off (Removal)

STATION #4. Overboots and gloves off (Removal)

STATION #5. Monitor

STATION #6. Mask removal

STATION #7. Mask decon point

STATION #8. Reissue point

SUPERVISE A DETAILED TROOP DECONTAMINATION SITE

Ensure the proper decontamination techniques are used at each station and that all checks for decontamination are adequate.

STATION #1 Individual gear drop. Decon gear by washing in decontaminant container and dipping into rinse water container. (Stack decontaminated equipment together.) The station attendant holds detection devices 1 meter from the pile and checks for residual contamination. If contamination levels exceed negligible risk, then the equipment should be recycled and decontaminated again. If the equipment passes the check, it is placed on the clean side of the contamination control point. Depending on the amount of time available, more extensive washing and checking procedures may be useful. This technique outlines the minimum that should be done. However, as time becomes available, you may decide to wash equipment longer or let it air outside after washing. These methods further reduce the amount of agent vapors desorbing (or bleeding) out of pistol belts, mask carriers, helmet covers, and other items.

Equipment may be put in closed areas and checked for hazardous vapors with the M256 chemical detector kits. These additional steps take valuable time. Unit commanders must decide if these additional steps are cost effective.

STATION #2. Overboot and decon. For all types of contamination a contamination control area for runoff such as a trench will be constructed around this station. For chemical/biological contaminant: Individual will walk into shuffle pit, kick decontaminant onto boots and lower trouser legs, and proceed to remove or decontaminate hood.

- If a replacement hood is available, cut the hood off the mask as follows: Cut off the underarm straps and neck cord of your buddy's hood. Pull the hood inside out over the front of his mask, being careful not to touch your buddy's neck or head. Gather the hood in one hand. Use scissors to cut away the hood. Cut as close to the eyelenses, voicemitter, and inlets as possible. Make sure nothing is left dangling below the bottom of mask. Let your buddy repeat the procedures on you.

- If a replacement hood is not available, roll the hood as follows: Loosen your buddy's neck cord and hood straps. Use the skin decon kit to decontaminate the hood. Then decon your own gloves. Grasp the straps on your buddy's hood and lift the hood straight up off his/her shoulders. Leave the zipper on the hood closed. Pull the hood over the head until most of the back of the head is exposed, but do not pull it completely over the face. Attach the straps to the velcro patches on the hood. Roll the hood by starting at the chin and working around the mask. Roll it tightly without pulling it off the back of the head. Let your buddy repeat the procedure on you.

STATION #3. Overgarment-off. This procedure is identical to the procedure used for MOPP gear exchange using the buddy system.

STATION #4. Overboots and gloves-off.

- At this station, a "hot line" is marked on the ground. It is a control line beyond which there should be no liquid contamination. Remove your own overboots without help as follows: Cut and remove the laces of the overboots; Stand next to the hot line; remove the first overboot. Pull the boot off; do not kick it off. Put the bootless foot on the clean side of the hot line. Put the overboot in a container or pile on the contaminated side of the "hot line". Remove the other overboot in the same way. Remove protective gloves and discard in the container.

- Attendant from station 6 will meet personnel wearing M24/M25A1 masks at this station. The attendant will carry the canister for that person until the person's mask is removed at station 6.

STATION #5. Monitor. Check for contamination. Decon areas as required. Administer first aid as required. Presently fielded chemical detection equipment can detect small quantities of agent vapor but cannot specifically locate it on personnel. Liquid agent can be detected by detection paper. Symptoms of agent poisoning are the most obvious indication of skin contamination. So, at this step, the medic checks each soldier for symptoms. Soldiers processing through this station should report any damage to their MOPP gear that was identified in station 2. Any areas identified as contaminated can be treated with a appropriate decontaminant by the station attendant (medic).

STATION #6. Mask Removal.

- If hood is still attached to mask, attendant pulls hood over front of mask, grabs mask by voicemitter cover, and pulls off soldier. Soldier holds breath as mask is removed, walks upwind 5 meters, crosses the vapor hot line, and then resumes breathing. Station attendant brings mask to station 7, mask decon point.

- This station has a "vapor hazard" control line, beyond which vapor hazard is not expected, as long as the wind direction and velocity are constant. Position an automatic chemical agent alarm to warn of vapor hazards. The person getting deconned moves straight ahead while his mask, which may still give off vapors, is held on the hot side of the line and taken to station 7 where it is deconned.

STATION #7. Mask decon point. Discard mask hood and filters into marked containers. Remove mask eyelens outserts and decon them. Remove and discard cannisters from M24/M25A1 masks. Decon mask and hose. Ensure mask eyelens inserts remain inside mask. Wash mask and outserts (and hose on M24 or M25A1) in hot, soapy water. Rinse in clean water, dip into sanitizing solution. (Add one tube of mask sanitizing solution [calcium hypochlorite, technical] to one canteen of water. Use four canteens to make one gallon). Wipe with paper towels until almost dry. Change each gallon of mask sanitizing solution after every 10 masks. An attendant checks for contamination. If the mask is still contaminated the attendant recycles it for more decon and then decons his gloves. If the mask is not contaminated the attendant must ensure he does not contaminate himself or the reissue point.

STATION #8. Reissue point. Mask components provided to individual, who assembles own mask with new filters, hood, and clean outserts in the assembly area. Company chemical NCO will affix cannisters to M24/M25A1 hoses. Individuals pick up individual gear and move to assembly area.

CLEAR THE DETAILED TROOP DECONTAMINATION SITE

CONDITIONS

Given a situation or sketch of a detailed troop decontamination operation, pencil, and paper.

STANDARDS

The student will correctly answer 8 of the 10 questions.

PERFORMANCE MEASURES

1. Pick up all used supplies and place them in the discard container at station 7 (mask decon point). Move the discard, wash, rinse, and sanitizing containers to the sump, empty them, and move them to station 1.
2. Take up the vapor agent contamination control line at station 6 (mask removal), if engineer type was used, and dispose of it in the sump.
3. Dispose of any used supplies from station 4 (boots and gloves off) in the sump. When conducting chemical/biological decon, empty the station 4 containers in the sump and move them to station 1. Pick up the remaining reusable supplies and equipment.
4. Empty the discard containers from station 4 and 3 in the sump and move them to station 1. Dispose of any unusable supplies from stations 4 and 3 in the sump. Move reusable equipment from these stations to station 1.
5. If conducting biological decon, move the shovel from station 2 to station 1. Dispose of any unusable supplies from station 2, into the sump. Move reusable supplies and equipment to station 1.
6. Decon all supplies and equipment collected at station 1, using the decontaminant and rinse water at station 1. Empty the rinse and decon containers from station 1 in the sump.
7. Mark entire decon area. Remove overgarments using the MOPP gear exchange technique and dispose of the overgarments in the sump. Fill in sump and mark it. Decon equipment used to close down sump, as required. If it is chemical/biological contaminant, use a skin decon kit.

8. Decon gloves and move (all equipment and supplies at station 1) upwind of the decon area.
9. Remove your footwear covers and gloves which may now be contaminated. Dig a hole and bury them, mark the hole.

CLEAR THE DETAILED TROOP DECONTAMINATION SITE

The step for clearing the troop decontamination site are as follows:

Step 1. Pick up all used supplies and place them in the discard container at station 7 (mask decon point). Move the discard, wash, rinse, and sanitizing containers to the sump, empty them, and move them to station 1.

Step 2. Take up the vapor agent contamination control line at station 6 (mask removal), if (if engineer type was used), and dispose of it in the sump.

Step 3. Dispose of any used supplies from station 4 (overboots and gloves off) in the sump. When conducting chemical/biological decon, empty the station 4 containers in the sump and move them to station 1. Pick up the remaining reusable supplies and equipment.

Step 4. Empty the discard containers from station 4 and 3 in the sump and move then to station 1. Dispose of any unusable supplies from station 4 and 3 in the sump. Move reusable equipment from the these stations to station 1.

Step 5. If conducting biological decon, move the shovel from station 2 to station 1. Dispose of any unusable supplies from station 2, into the sump. Move reusable supplies and equipment to station 1.

Step 6. Decon all supplies and equipment collected at station 1 using the decontaminant and rinse water at station 1. Empty the rinse and decon containers from station 1 in the sump.

Step 7. Mark entire decon area with standard NBC marker. Remove overgarments using the MOPP gear exchange technique and dispose of the overgarments in the sump. Fill in sump and mark it. Decon equipment used to close down sump, as required. If it is chemical/biological contamination, use the skin decon kit.

Step 8. Decon gloves and move all equipment and supplies from station 1, upwind of the decon area.

Step 9. Replace your footwear covers and gloves, which may be contaminated. Dig a hole and bury them. Mark the hole with standard NBC marker.

PROCESS THROUGH A DETAILED EQUIPMENT DECONTAMINATION SITE

CONDITIONS

Given a situation where you are contaminated with a chemical agent and are required to process through a detailed equipment decontamination site. List, in writing, the station sequence in which your contaminated vehicle will process through the decontamination site.

STANDARDS

The list is 100% accurate.

PERFORMANCE MEASURES

STATION #1. Primary wash

STATION #2. DS2 application

STATION #3. Wait time

STATION #4. Rinse

STATION #5. Interior decon

STATION #6. Check

PROCESS THROUGH A DETAILED EQUIPMENT DECONTAMINATION SITE

General Guidance

This technique requires a large water supply. Decon site should be set up near a good water source such as public water system, (fire hydrant), river, or large ponds.

Stations should be 30 to 50 meters apart.

Soldiers involved with washing, applying decontaminants, and rinsing must wear TAP aprons or wet weather gear to protect their overgarments.

While in the pre-decon area, or prior to entering the decon site, vehicles and equipment are prepared for decon. Exterior-mounted supplies and equipment susceptible to damage by decontaminants or decon procedures are removed and deconned.

There are two variations of the detailed equipment decontamination technique. For chemical and biological contamination there are six-stations. Decontamination of radiological contamination will be discussed later.

The six stations for chemical or biological contamination are outlined below.

STATION #1. Primary wash. This step removes the gross contamination and dirt on the vehicle. This step is similar in purpose and procedure to the wash step (station 2) in the vehicle washdown technique under unit sustainment decontamination. Spray hot, soapy water on the entire vehicle surface, including the undercarriage and engine compartment. Although the under surfaces are difficult to reach, effort should be made to remove as much dirt as possible. Most of the contamination will be removed with the dirt. Use caution in spraying water on hot engines; do not spray the engine itself, but spray the whole compartment. Engine heat will decon the engine. Clean off all the dirt you can see on the vehicle and you will have satisfactorily accomplished this step.

STATION #2. DS2 application. DS2 applied to vehicles will decon toxic chemical and biological agents. This step is physically more strenuous than any other, so steps must be taken to prevent exhaustion. Each chemical squad member is paired with a soldier from the contaminated unit to form a "scrub team". A second "scrub team" provides relief for the first team by alternating with it periodically. The chemical squad leader supervises the rotation of scrub teams. The scrub team applies DS2 and scrubs it into the surface of the vehicle. Scrubbing the undercarriage may be difficult. Every effort should be made to at least cover the undercarriage with decontaminant. The teams use the MI3 decon apparatus (DAP) or any similar device. Alternate methods of applying DS2 are sponge mops, brushes, or brooms.

STATION #3. Wait Time. DS2 requires 30 minutes to come in contact with agent that has seeped into cracks and crevices. Move vehicles to a concealed holding area. Record the time the vehicle enters the holding area. Allow 30 minutes for the DS2 to neutralize toxic chemical agents. Then move the vehicle to the next station.

STATION #4. Rinse. For chemical and biological contamination, this step rinses off DS2 and neutralizes agent.

STATION #5. Interior decon. This step concentrates on deconning the crew compartment and cargo area. It also serves as the driver exchange point. Contaminated drivers dismount the vehicle before the step begins and deconned assistant drivers mount after the step is complete. Vehicle driver opens all hatches from the inside before leaving the vehicle. The decon platoon enters the crew compartments and cargo areas to run decon checks and do appropriate decon. After decon crew identifies first contaminated vehicle, hazard transfer will occur when moving to next vehicle unless specific decon actions are implemented i.e., shuffle pit before mounting next vehicle.

STATION #6. Check. This step is the key to detailed decon, which allows the MOPP level to be lowered. As much contamination as possible needs to be removed, or the MOPP level will not be lowered. This is the "GO/NO GO" step which tells you if significant contamination is still present. Detection procedures will vary depending on the type of contamination. If contamination is detected on equipment, the equipment must be recycled through decon. Use M8 or M9 chemical detector paper to blot various dry surfaces on the vehicle. Two soldiers are required from the contaminated unit. One should be the assistant company decon team chief. They use their organic detection equipment to determine whether their vehicles are sufficiently decontaminated or require recycle.

PERSONNEL REQUIREMENTS FOR
DETAILED EQUIPMENT
DECON STATION

STEP	ATTENDANT'S ACTION	DECON CONTAMINATED	
		SQUAD	COMPANY
(1) Wash	PDDE crew washed equipment	3	0
(2) Apply	1 Supervisor and 2 Scrub teams apply DS 2	3	2
(3) Hold	Attendant positions/times equipment	0	1*
(4) Rinse	PDDE crew rinses equipment	3	0
(5) Interior Decon	1 Supervisor and 2 Deconners decon interior	3	0
(6) Check	2 attendants check decon effectiveness	0	2*
*Co Decon Team Members			
	Sub Total	12	5
	Plus Decon Plt. HQ's	3	0
	Total	15	5

Decon Plt HQs: Provides platoon leaders, platoon NCO, driver/radio telephone operator.

Contaminated Co:

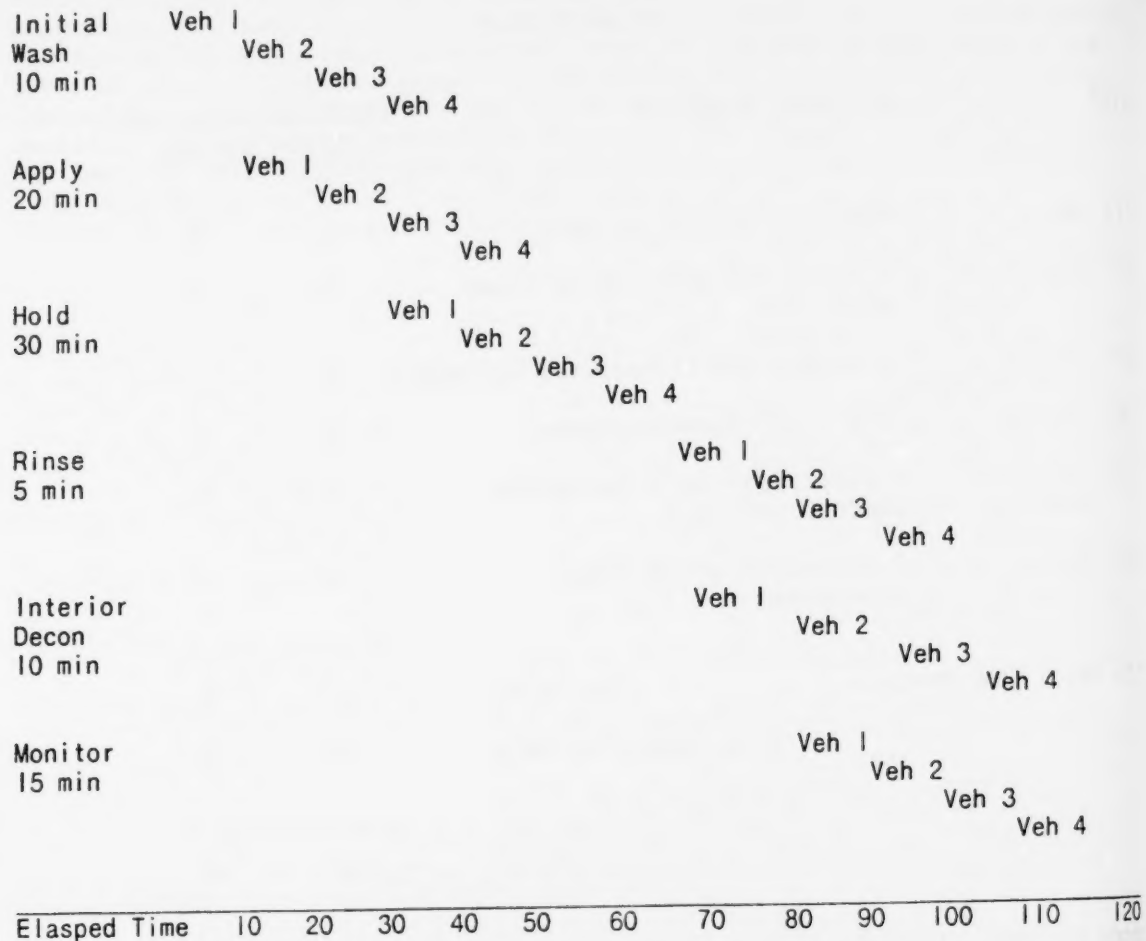
Provides - Assist Co Decon team chief and another company team member to check equipment at station 6.

- Decon team member to run station 3.

- Two non-decon team members to scrub at step 2.

DETAILED EQUIPMENT DECON PLANNING CHART

STOP FLOW OF VEHICLES THROUGH DECONTAMINATION STEPS



EFFORTS TO REDUCE CONTAMINATION

Natural decontamination of radioactive agents. Aging, removing, and sealing are the principle natural decontaminants used to decontaminate radioactive agents.

Radiological contamination isn't affected by weather. Radiation hazards decay at a particular rate depending upon the atomic characteristics of specific particles. This process is called aging. It's a practical technique for deconning because it requires no labor and reduces the soldier's exposure to radiation. Check the aging progress periodically by monitoring. Consider using aging whenever possible, especially in tactical situations where manpower is of primary importance.

Removal of radioactive contamination is in most cases the most costly of decontamination procedures. Decontamination of large areas would require engineer assets, whereas moving the earth around fighting positions would only require a shovel. Even when moved the contamination will remain a hazard until radiation decays to less than 0.33 cGy(rad)/hr.

Covering or burying radioactive contamination with earth will act as a shield and reduce the level of radiation. Earth is only a temporary sealant for radiological contamination. Terrain such as drainage ditches or collection sumps contaminated with radiation can be effectively sealed with 30 centimeters (12 inches) of earth. Eight centimeters (3 inches) of earth will reduce the dose rate by approximately one-half.

Water can be used to control radioactive dust, contamination on the ground, and prevent the agent from becoming airborne. Boiling may help remove some radiological contamination by getting the dirt out of the contaminated material, however, it doesn't reduce the radioactivity of contamination, and the water will become contaminated.

Radiological contamination is not affected by the variables that affect chemical contamination. You can derive a general idea of the persistency of radiological hazards by taking readings of radiation dose rates. You can also use the "7-10 rule" as a rule-of-thumb to estimate future radiation levels for operational purposes. The 7-10 rule provides only a very general estimate which should be used only for planning purposes. The rate of radioactive decay is proportional over time. So the 7-10 rule means that for every 7 multiples of time, radiation intensity will decrease by a factor of ten.

The process of individual sustainment for radiological contamination in most cases is relatively simple. Radiological contamination can be readily detected and located with monitoring equipment. Remove the contamination and you remove nearly all of the hazard. Brush the dust off your load-bearing equipment and mask carrier. If you are contaminated with a dry contaminant, such as fallout, shake your clothing and gear. Wash exposed areas of your skin. Use M258A1 towelettes if soap and water are not available. Pay particular attention to your hair and fingernails. Avoid breathing the dust you shake off. If you were contaminated by wet radiological contaminant you must conduct a MOPP gear exchange as soon as possible because brushing or shaking will not remove the hazard. Wash gloves and footwear covers if water is available. Wipe off your mask, hood, helmet, and other personal equipment with warm, soapy water. If warm, soapy water is unavailable use rags or damp paper towels. Ensure contamination is not spread to clean areas.

As with the personnel wipedown technique, the operator spraydown technique is as uncomplicated. Operator spraydown may be a misnomer. Operator washdown or operator brushdown is more appropriate for radiological contamination.

If you are contaminated by fallout, rainout, neutron-induced contamination, or any type of radiological agent, use your monitoring equipment to help locate the radiological agent, used in your work area. Then decon as required. If detection equipment is not available and you are suspect you are contaminated -- decon.

Radiological contamination can normally be removed by brushing or scraping (use brooms or tree branches). Water is effective for flushing away radiological contamination. Control the runoff so that any contaminated residue will not be spread. Remember, you haven't destroyed the contamination, just moved it. The runoff will be hazardous. If you have time, brushing or scooping away the top inch of soil from your fighting position will lower the amount of radiological contamination hazard affecting you.

MOPP GEAR EXCHANGE TECHNIQUE

Equipment and Personnel Requirements Recapitulation

For Radiological Decon: Material optional if hot water is available. Use the following items to wash equipment. Otherwise, brush, wipe, or shake off radiological contamination. Then follow with the procedures for chemical decon using M258A1 towelettes.

- Three pails (approximately 3-gallon capacity)
- One can GI soap or liquid detergent
- Water for mask wash and rinse
- Two sponges
- Paper towels

Personnel:

- Two personnel from company decon team or the squad leader and assistant are required to set up and supervise the MOPP gear exchange area.

VEHICLE WASHDOWN

Do this procedure the same way for radiological contamination as was done for chemical contamination. The gains made conducting this technique for radiological contamination could be greater.

DETAILED PERSONNEL DECONTAMINATION

When discussing decontamination of radiological contamination you must consider that radiological contamination alone may not be present. The use of nuclear weapons, under current Soviet doctrine, will probably be used only after all conventional means (which includes the use of chemical fires) have failed to obtain their objective. If chemical fires are not included initially, then the employment of chemical and nuclear occurring simultaneously to support meeting their objective should be assumed. None of the less, the threat of the use of chemical weapons will prompt US forces into some MOPP posture early on. Therefore, the procedures detailed for personnel decontamination will assume that protective overgarments, footcovers, and maybe mask, hood, and gloves are worn. In the event that they are not worn, the procedures remain essentially the same substituting current battle dress for overgarments in the procedure.

Material as required at each station.

STATION #1: Individual gear drop. Remove as much contamination as possible from the individual equipment (load-bearing equipment, mask carrier, helmet, and weapon).

a. For all forms of contamination:

- (1) Two 30-gallon containers (one for decontaminants, one for rinse).
- (2) Two long-handled brushes (to scrub equipment).
- (3) Water (for rinse).

b. For radiological contamination:

(1) Decontaminant (hot, soapy water).

(2) AN/PDR 27 radiometer.

STATION #2: Overboot and hood decon. Remove gross contamination from hood and mask. For radiological decontamination only a shuffle pit is not required and no footwear decontamination is needed. (This station may be deleted if mask was not worn during the operation.)

a. For all types of contamination:

Cutting tool to remove hoods.

b. For radiological contamination:

(1) One container for hot, soapy water with sponge for mask wash.

(2) One container for rinse water with sponges.

(3) One case paper towels per company.

STATION #3. Overgarments off. Two containers.

STATION #4. Overboots and gloves off:

a. Cutting tool (to remove overboots).

b. Draw line on the ground or use engineer type as a hot line to separate the "dirty" from "clean" areas. Exception to this clean area will be the dirty gloves.

c. Two containers (one on dirty side on line for overboots, one on clean side for gloves).

STATION #5. Monitor.

a. For all types of contamination: First aid supplies.

b. For radiological contamination: Using your company level radiometer, AN/PDR27, you can determine specifically how much radiological contamination remains. By monitoring decontaminated equipment, you can quickly determine if contamination levels are low enough to present only negligible risks. When negligible risk levels (0.33 cGy [rads] per hour) are reached, no further decon is required.

- (1) AN/PDR27.
- (2) Two buckets.
- (3) Hot, soapy water for decon.
- (4) Water for rinse.
- (5) Two sponges.

STATION #6. Mask removal. No material required. (This station may be deleted if mask was not worn during the operation.)

STATION #7. Mask decon point. (This station may be deleted is mask was not worn during the operation.)

a. For all types of contamination:

- (1) Three buckets (one for soapy water, one for rinse water, one for mask sanitizing solution).
- (2) One container to discard filter elements and other refuse.
- (3) Hot, soapy water (for wash).
- (4) Sanitizing solution.
- (5) Water for mask rinse.
- (6) Four sponges.
- (7) One case of paper towels to dry masks during refit process.

STATION #8. Reissue Point. Same as when decontaminating CB hazards.

DETAILED EQUIPMENT DECONTAMINATION

General Guidance. The guidance for decontamination of radiological hazards using the detailed equipment decontamination method remains the same as was discussed in Unit 3 when decontaminating chemical and biological agents.

This technique requires a large water supply. Decon site should be set up near a good water source such as public water system (fire hydrant), river, or large ponds.

Station should be 30 to 50 meters apart.

Soldiers involved with washing, applying decontaminants, and rinsing must wear TAP aprons or wet weather gear to protect their overgarments. (Only required when both chemical/biological and radiological contamination occur concurrently).

While in the pre-decon area or prior to entering the decon site, vehicles and equipment are prepared for decon. Exterior-mounted supplies and equipment susceptible to damage by decontaminants or decon procedures are removed and deconned separately.

There are two variations of the detailed equipment decontamination technique. For chemical and biological contamination there are six steps.

STATION #1. Primary wash.

STATION #2. DS2 application.

STATION #3. Wait time.

STATION #4. Rinse.

STATION #5. Interior decon.

STATION #6. Check

For radiological contamination only, there are four steps.

STATION #1. Primary wash.

STATION #2. Rinse

STATION #3. Interior decon.

STATION #4. Check.

A minimum of two chemical decon squads are required to set up and run the detailed equipment decontamination site.

PROCESS THROUGH A DETAILED EQUIPMENT DECONTAMINATION SITE

Vehicles are processed through four stations for radiological contamination.

STATION #1. Primary wash. This step removes the gross contamination and dirt on the vehicle. This step is similar in purpose and procedure to the wash step (Station 2) in the vehicle washdown technique under unit sustainment decontamination. Spray hot, soapy water on the entire surface including the undercarriage and engine compartment. Although the undersurfaces are difficult to reach, an effort should be made to remove as much dirt as possible. Most of the contamination will be removed with dirt. Use caution in spraying water on hot engines; do not spray the engine itself, but spray the whole compartment. Clean off all the dirt you can see on the vehicle and you will have satisfactorily accomplished this step.

STATION #2. Rinse. For radio active contamination, this step rinses off the soapy water and provides an additional flushing step for removing contamination.

STATION #3. Interior decon. This step concentrates on deconning the crew compartment and cargo area. It also serves as the driver exchange point. Contaminated drivers dismount after the step is complete. Vehicle driver opens all hatches from the inside before leaving the vehicle. The decon platoon enters the crew compartments and cargo areas to run decon checks and do appropriate decon. After decon crew works on the first contaminated vehicle, hazard transfer may occur when moving to next vehicle unless specific decon actions are implemented.

STATION #4. Check. This step is key to detailed decon--to remove as much contamination as possible. This step gives you the "go" or "no go" to do that. It tells you if significant contamination is still present. If more than .33 cGy/hr is detected on equipment, the equipment must be recycled through decon. Use the AN/PDR27 radiaometer to check for any radiological contamination present. Two soldiers are required from the contaminated unit. One should be the assistant company decon team chief. They use their organic detection equipment to determine whether their vehicles are sufficiently deconned or require recycle.

PREPARE FOR NBC ATTACK

CONDITIONS:

Given a situation where your unit is performing its mission. Threat forces have either used nuclear, biological, or chemical (NBC) weapons or are likely to do so. You must prepare yourself and your unit in case these weapons are used against you.

STANDARDS

Demonstrate your ability to prepare an NBC attack by answering 8 out of 10 multiple-choice questions correctly.

PERFORMANCE MEASURES

1. Cover supplies and equipment with plastic sheets. If plastic is not available, use a tarpaulin or other similar material. As a minimum use foliage.
2. Keep ammunition in its container as long as you can. Cover exposed ammunition.
3. Cover weapons or put under foliage.
4. Keep instruments in their containers when they are not being used.

5. Park vans so the air conditioners are away from prevailing winds. Park vehicles in woods. Spread them out and cover them when possible.
6. Cover unsheltered communications equipment. Cover radio headsets and telephone mouthpieces with plastic.
7. Put overhead cover on field latrines.
8. Open food only when ready to eat it.
9. Store unpackaged food in iceboxes.
10. Keep water in sealed containers.
11. Dig in supplies and equipment.
12. Pick up loose items. Secure them so they do not become missiles.
13. Turn off all electronic equipment you do not have to use. Remove power cables and antennas. Keep this equipment inside bunkers and armored vehicles to protect against electromagnetic pulse (EMP).

REFERENCES

FM 21-3, Task 031-503-3007

SUPERVISE PROTECTION OF PERSONNEL, SUPPLIES, AND EQUIPMENT

An explosion, in general, results from the very rapid release of a large amount of energy within a limited space. This is true for a conventional "high explosive," such as TNT, as well as for a nuclear explosion, although the energy is produced in different ways. The sudden liberation of energy causes a considerable increase to temperature and pressure, so that all the materials present are converted into hot, compressed gases.

Nuclear weapons are similar to those of more conventional types insofar as their destructive action is due mainly to blast or shock. On the other hand, there are several basic differences between nuclear and high-explosive weapons. In the first place, nuclear explosions can be many thousands (or millions) of times more powerful than the largest conventional detonations. Second, a fairly large proportion of the energy in a nuclear explosion is emitted in the form of light and heat, generally referred to as "thermal radiation." It is capable of causing skin burns and starting fires at considerable distances. Third, the nuclear explosion is accompanied by highly penetrating and harmful "initial nuclear explosion are radioactive, emitting radiation over an extended period of time. This is known as "residual nuclear radiation."

It is because of these fundamental differences between a nuclear and conventional explosion that the effects of nuclear weapons require special consideration. In this connection, a knowledge and understanding of the mechanical and the various radiation phenomena associated with a nuclear explosion are of vital importance.

In the case of conventional explosions, the energy arises from chemical reactions involving a rearrangement among the atoms present in the chemical high-explosion material. In a nuclear explosion, however, the energy is produced as a result of the formation of different atomic nuclei by the redistribution of the protons and neutrons within the interacting nuclei.

There is a definite equivalence between mass and energy ($E = mc^2$), and when a decrease in mass occurs in a nuclear reaction, there is an accompanying release of a certain amount of energy related to the decrease in mass. Two kinds of nuclear interactions can satisfy the conditions for the production of large amounts of energy in a short time - "fission" and "fusion."

A fission explosion is a process whereby the nucleus of a heavy element (usually uranium or plutonium) splits into two lighter elements with the release of a large amount of energy. [The complete fission of 1 pound of uranium or plutonium releases as much energy as the explosion of 8,000 tons (8 KT) of TNT.]

In a fusion reaction, a pair of light nuclei unite or fuse together to form a nucleus of a heavier atom. A light element commonly used as deuterium nuclei combine to form the nucleus of helium, with the release of energy. A fusion reaction can be accomplished by means of very high temperatures and is often referred to as a "thermonuclear process." [The fusion of all the nuclei present in 1 pound of deuterium releases roughly the same amount of energy as the explosion of 26,000 tons (26 KT) of TNT.]

Recognize a Nuclear Attack

The effects of a nuclear explosion are many times greater than the effects of a conventional explosion. To recognize a nuclear attack, you must know what happens when a nuclear explosion occurs. You should know some of the terms and elements related to nuclear hazards.

A Nuclear Burst. When a nuclear explosion occurs, a tremendous amount of energy is released. This energy is called Yield. Yield is measured in kilotons and megatons. A kiloton is the equivalent amount of explosive energy released when 1,000 tons of TNT explode. A 20-KT nuclear explosion releases as much explosive energy as 20,000 tons of TNT. A megaton is the equivalent amount of energy released when one million tons of TNT explode. A 15-MT nuclear explosion releases as much energy as 15 million tons of TNT.

All the energy from the nuclear explosion is released within a fraction of a second and within a very small area. Everything in that small area--the bomb casing, unexploded nuclear fuel, dirt; trees, buildings--is heated so hot that it vaporizes or turns into gas. These gases form a highly pressurized, glowing, white hot mass called the fireball. As the fireball cools, it rises, expands, and generates tremendous turbulence; it causes the familiar mushroom-shaped cloud associated with certain types of nuclear explosions.

The effect of a nuclear explosion will vary by its height-of burst, which refers to whether the explosion was at the surface of the ground, in the air, or below ground. An airburst refers to a nuclear explosion high enough above the surface of the earth so that the fireball does not touch the ground. An airburst will form a white cloud up in the air, but without the "mushroom" stem.

A surface burst explodes on or close to the surface of the earth. The fireball touches the surface and produces a dark-colored and heavy-looking cloud with a mushroom stem. A subsurface burst is an explosion centered below the surface of the earth or underwater. The force of the explosion may be held underground or break through the surface, depending on the depth of the explosion. If the subsurface burst stays underground, no cloud will be formed; it may feel like an earthquake.

The location where a nuclear weapon explodes is called ground zero. Ground zero is the point on the ground where a surface burst occurs, the point on the ground under an airburst, or the point on the ground above a subsurface burst.

Fireball

As a result of the nuclear explosion, the fission products, bomb casing, and other weapon parts are raised to extremely high temperatures, similar to those in the center of the sun. The maximum temperature attained by these residues is several tens of millions of degrees - compared with a maximum of approximately 5,000° (9,000°F) in a conventional high explosive weapon. Because of this great heat, all the materials are converted into gaseous form. Since the gases, at the instant of explosion, are restricted to the region occupied by the original materials, tremendous pressures will be produced - probably over a million times the atmospheric pressure.

Within less than a microsecond (a millionth of a second) of the detonation of the weapons, the extremely hot weapon residue radiates large amounts of energy, mainly as X-rays, which are absorbed within a few feet in a sea level atmosphere. This leads to the formation of a hot and highly luminous, spherical mass of air and gaseous weapon residue called the "fireball."

Immediately after its formation, the fireball begins to grow in size while decreasing in brightness. The fireball produces the basic effect of a nuclear detonation.

Height of burst. The effects of a nuclear explosion vary with the location of the point of burst in relation to the surface of the earth.

An airburst is defined as one in which the weapon is exploded in the air at such a height that the fireball does not touch the surface of the earth. An airburst usually produces the most damage to military targets, but does not produce militarily significant fallout.

A surface burst is one in which the point of detonation is below the surface of the earth, or at such a height above the surface that the fireball will touch the earth. The effects from the surface burst are normally less than those of an airburst; it does, however, produce militarily significant fallout.

A subsurface burst is one in which the point of detonation is below the surface of the earth. Most of the energy will, of course, appear as underground effects; however, if the fireball ruptures the surface of the earth, there may be an appreciable escape of the effects. A subsurface burst may not produce fallout; however, if the fireball ruptures the earth, fallout can be expected.

Basic effects

Nuclear weapons effects may be categorized as blast (or shock), thermal radiation (heat and light), and nuclear radiation. Of these, only blast and heat are found in a conventional HE explosion. For a typical airburst, blast comprises 50% of the total energy; thermal radiation, 35%; and nuclear radiation, 15%.

Effects of a Nuclear Attack. Nuclear weapons cause casualties and damage to material through the effects of blast, thermal radiation, nuclear radiation, and electromagnetic pulse (EMP). These effects will vary according to the height of a burst, explosive yield of the weapon, and distance of personnel or material from ground zero.

Blast. At a fraction of a second after a nuclear detonation, a high-pressure wave develops and moves outward from the fireball. This is the blast wave, and is the cause of most of the destruction accompanying a nuclear burst. The front of the wave travels rapidly away from the fireball, behaving like a moving wall of highly compressed air. As an example of the speed of the blast wave, consider the following: After a lapse of 10 seconds, when the fireball of a 1-megaton burst has attained its maximum size, the front of the blast wave has already traveled over 5 kilometers. One effect of the blast wave is called static overpressure. This is the pressure on the human chest to collapse the lungs. This effect decreases as the distance from ground zero increases. The high-speed winds propel objects, such as tree limbs or debris, at great speeds, turning them into potentially lethal missiles. These winds can also physically throw, at great speeds, any individual who is not protected, resulting in casualties. Individuals, both inside and outside of a structure, may be injured as a result of blast damage to the structure; those inside, by the collapse of the structure and fire; and those outside, by the flying objects carried by the winds. As the blast wave travels outward, it leaves in its wake a lessening of air pressure that acts like a vacuum. This effect causes additional destructive winds that rush back toward ground zero to fill up the vacuum.

Blast effect

Blast is the most destructive nuclear weapon effect. The blast wave is transmitted in all directions from the point of detonation as the hot gases in the fireball expand.

Blast is measured in terms of overpressure; i.e., pressure above atmospheric pressure (14.7 PSI).

The front of the blast wave (shock front) is a moving wall of highly compressed air. When the wave breaks away from the fireball, it is traveling at 5 to 7 times the speed of sound. For a 1 MT burst, the blast wave travels more than 12 miles before its velocity drops to the speed of sound at sea level.

Blast damages both material and personnel. Material targets are damaged by the direct effect of the blast wave; while injury to personnel occurs primarily from indirect effects; for example, flying objects or falling structures.

Blast pressures are of two types: static overpressure and dynamic pressure.

Static overpressure is the crushing effect exerted by the blast wave at a given location. It causes damage to crushing or diffraction type targets, such as buildings. The damage mechanism is a pressure differential.

Dynamic pressure is exerted by the strong winds accompanying the blast wave. It causes damage to drag or roll type targets such as military vehicles.

The passage of the blast wave is characterized by a variation of pressure with time.

Thermal radiation

Thermal radiation is produced when energy from the nuclear detonation is absorbed by the surrounding atmosphere. The weapon residues are vaporized and absorbed by the atmosphere to create a luminescent fireball, the temperature of which is millions of degrees centigrade.

Thermal radiation is emitted in two pulses

The first pulse is of extremely short duration. It is emitted between the formation of the fireball and the formation of the shock wave. When the shock wave forms, it is so dense that thermal energy cannot pass through.

The second thermal pulse is emitted after the shock wave breaks away from the fireball. The pulse contains most of the thermal energy and is emitted at a lower temperature than the first pulse.

Thermal Radiation. Thermal radiation is the first effect of a nuclear burst that can be seen and felt. It is the combination of heat and light resulting from the formation of the fireball.

Heat. Within less than a millionth of a second of the detonation of a nuclear weapon, the residue radiate great amounts of energy. This leads to the formation of the fireball. To an observer 80 kilometers away, the fireball of a 1-megaton weapon would appear to be many times more brilliant than the sun at noon. Although the brightness of the fireball does not vary greatly with the yield of the weapon, the yield does dictate the duration of the fireball. The heat radiated from the fireball contributes to the overall damage caused by a nuclear burst by igniting combustibles and thus starting fires in buildings and forests. These fires may spread rapidly among the debris produced by the blast. In addition, this heat is capable of causing skin burns to exposed individuals at great distances from ground zero. The distance to which this effect will cause injury, however, is highly dependent on the weather and terrain. During periods of limited visibility, the heat effect will be reduced significantly from what it would have been in clear weather.

Light. The fireball formed at the instant of a nuclear detonation is a source of extremely bright light. This light can cause injuries to individuals in the form of temporary or permanent blindness. Temporary blindness from a burst during daylight should be of very short duration and is not an important consideration for individuals other than aircraft crewmen. At night, this loss of vision will last for longer periods because the eyes have been adapted to the dark. Recovery, however, should be completed within 15 minutes. The light flash can cause permanent injury to the eye due to burns within the eye itself, but this is only likely to occur in those individuals who happen to be looking directly at the fireball at the instant of detonation.

Effect of Thermal Radiation on the Body

The radiation can cause flash burns, which are similar to burns received by being in the sun too long. The difference is that flash burns happen very quickly. These burns may be first degree, second degree, or third degree, depending upon how close the soldier is to the nuclear burst.

Nuclear radiation

Initial nuclear radiation includes all the nuclear radiation emitted within 1 minute after the detonation. It comprises 5% of the total bomb energy released, with the radiation of military significance consisting of gamma rays.

Nuclear Radiation. Nuclear radiation is a form of electro-magnetic energy that, in small doses as used in medicine, can be beneficial. In massive doses, as in a nuclear explosion, nuclear radiation can cause sickness and death.

Initial Nuclear Radiation. Initial nuclear radiation is that radiation emitted within the first minute after detonation. It consists primarily of neutrons and gamma rays. Both of these types of radiation, although different in character, can travel considerable distance through the air and can produce harmful effects in humans. Gamma rays are invisible rays similar to X-rays. These penetrating rays interact with the human body and cause damage to tissues and blood-forming cells. The effects of neutrons on the body effects of initial radiation results from the fact that a soldier may have received a lethal or incapacitating dose of radiation before being able to take any protective action.

Initial gamma radiation is produced by two processes.

- Capture of bomb neutrons by atmospheric processes.
- Decay of fission products.

Neutrons are emitted in both fission and fusion weapons. They are quite energetic, but are rapidly slowed by collisions with the surrounding media.

Residual nuclear radiation comprises about 10% of the total bomb energy and is divided into fallout and neutron induced radiation.

Fallout consists of a mixture of unfissioned bomb materials (alpha emitters) and fission products (beta, gamma emitters), and soil elements that have become radioactive (beta, gamma emitters).

Neutron induced radiation is produced when bomb neutrons strike certain elements in the soil, inducing them to emit beta and gamma radiation.

Nuclear radiation is measured in terms of the Gray. One Gray is equal to 100 rads and 1 rad is equal to the absorption of 100 ergs of energy per gram of absorbing material. Therefore, 1 rad is equal to 1 centigray (cGy). The term cGy and rad are interchangeable.

Residual Nuclear Radiation. Residual nuclear radiation is that which lasts after the first minute and consists primarily of fallout and neutron-induced radiation. The primary hazard of residual radiation results from the creation of fallout.

Fallout. Fallout is produced when material from the earth is drawn into the fireball, vaporized, combined with radioactive material, and condensed to particles which then fall back to which then fall back to earth. The larger particles fall back immediately in the vicinity of ground zero. The smaller particles are carried by the winds until they gradually settle to the surface of the earth. The contaminated area created by fallout may be very small or may extend over many thousands of square kilometers, and the dose rate may vary from a militarily significant level to an extremely-dangerous one for all personnel not taking necessary defensive measures.

Fallout of radioactive material from an airburst is not of military significance unless rain or snow falls through the radioactive cloud and brings the material to earth. Neutrons from the detonation will cause induced radiation in the soil around ground zero. Except for very high airbursts, neutron-induced radiation in the area of ground zero will be of concern to both mounted and dismounted personnel who are required to go into or across the area. Radiological monitoring will be required as units pass through such an area so that hazardous levels of radiation can be detected and avoided, if possible.

Induced radiation in a surface burst is present but will be masked by residual radiation from fallout. The fallout produced by a surface burst is by far its most dangerous effect in that it can cover thousands of square kilometers with high levels of radioactivity.

If the fireball of a subsurface burst breaks through the surface, fallout will be produced. Thermal radiation will not be a significant hazard since it will be almost completely absorbed by the soil. Blast effects will also be significantly reduced, but shock waves passing through the ground or water will extend for limited distance. The range of the initial nuclear radiation will be considerably less than from either of the other two types of bursts, because this will also be absorbed to a great extent by the soil. However, extremely hazardous residual radiation will occur in and around any crater. If the fireball does not break the surface, shock waves will pass through the ground and cause craters due to settling.

A secondary hazard which may arise is the neutron-induced radioactivity on the surface of the earth in the immediate vicinity of ground zero. The intensity and extent of the induced radiation field depends on the type of soil in the area around ground zero, the height of burst, and the type and yield of the weapon. The only significant source of residual radiation from an airburst weapon is induced activity in the soil of a limited circular pattern directly beneath the point of burst.

The electromegnetic pulse (EMP) is broad-band-width electromagnetic energy pulse of a short duration produced by a nuclear burst. The range of effect is measured in hundreds of kilometers for a high altitude air burst, and tens of kilometers for a surface burst. It does not affect personnel, but damages electronic equipment and blanket radio communications systems. Steps to counter EMP include: disconnect cables, dismantle or shorten antennas, and enclose electronic equipment in metal containers.

Effect of Nuclear Radiation on the Body

Initial nuclear radiation and residual radiation, or fallout, do not damage material; they damage human tissues. When radiation is absorbed by the body, it kills the body's cells. How much radiation a soldier can receive and still survive depends on such factors as the soldier's weight, general state of health, personal biochemistry, and whether the soldier has had previous exposure to radiation.

Radiation doses are measured in units called cGy(rad). Of soldiers who receive a dose of 0 to 70 cGy(rads), fewer than 5 percent will show early symptoms of radiation poisoning. Of soldiers receiving 800 cGy(rads), almost all will show symptoms, and fatalities will be above 50 percent within 45 days.

Symptoms of Radiation Poisoning

Symptoms of radiation poisoning may occur immediately if the dose received by the soldier was very high. Otherwise, the symptoms will appear within a few hours. Depending upon the dosage received, the symptoms may disappear after a short time and not return, or they may return again within a few days, or not for several weeks. When the symptoms do reappear, they may be more severe than they were initially, and can result in death. Radiation symptoms include:

- Weakness
- Nausea
- Vomiting or dry heaving
- Diarrhea
- Lethargy (lack of energy)
- Depression
- Mental disorientation
- Shock
- Coma

At present there is no cure for radiation sickness; however, the symptoms can be treated.

METHODS OF PROTECTING PERSONNEL, SUPPLIES, AND EQUIPMENT

React to a Nuclear Attack

The enormous and rapid effects of a nuclear burst make it imperative that soldiers be able to react quickly. Soldiers must know how to protect themselves against the three casualty-producing effects of the blast wave, thermal radiation, and nuclear radiation. Time is the critical factor in protection from a nuclear blast. If the possibility exists of a surprise nuclear attack, all personnel not engaged in any essential activity should remain under cover as much of the time as possible, because the time available for getting under cover will be so short, and exposure to some of the nuclear effects occurs almost simultaneously with the detonation. When given warning, a unit can perform several kinds of protective measures that cannot be done when an attack occurs without warning.

React When Given No Warning. When no warning has been given of an impending nuclear attack, soldiers must react the instant they see the bright flash of light. Depending on the size of the weapon and your distance from the burst, your unit may have only seconds to take cover. Defensive actions must be automatic. Heat comes with the bright light of the explosion, and a blast wave follows within seconds.

Prepare for Fallout. Depending on whether the burst was an airburst, surface burst, or subsurface burst, there may be a little fallout or a lot. As soon as the blast wave has passed, all soldiers should begin preparations to protect themselves, their equipment, and supplies from fallout. Everything that can be sealed should be. Every effort should be made to keep fallout out of foxholes or other shelters. Hatches, doors, windows, and other openings should be kept closed. Designated individuals begin monitoring using RADIAC instruments so that any fallout arriving in the unit will be detected. RADIAC instruments usually used to detect and measure radioactivity include the IM174 Series Radiometer, which is used for area monitoring and surveys, and the AN/PDR27 RADIAC Set, which is used for monitoring personnel, food, and equipment. When warned of the arrival of fallout, individuals take cover and remain protected until fallout has stopped, or until other instructions are received.

Soldiers should attempt to seek shelter in places that provide shielding against the radiation from fallout. Lead, steel, concrete, and earth all provide protection. Overhead protection is essential. Since earth absorbs radiation, the deeper the foxhole, the greater the protection. If fallout arrives when you are out in the open, it is better to enter available shelter with some fallout on you than to remain outside without shielding.

Remove Fallout. Because fallout is a fine dust, it can be partially removed by brushing or dusting it off. If you are going to enter a shelter and you have fallout on you, you should remove as much of it as possible before you enter the shelter. The best way to remove fallout, however, is to wash it off. If at all possible, soldiers should shower, being especially careful to remove fallout dust from their hair, under their nails, or in any cuts, scrapes, or open wounds. Clothing should be laundered or exchanged, if possible. Fallout also should be washed, wiped, brushed, or blown off all personal equipment.

CAUTION

Fallout left in contact with skin causes skin burns similar to first, second, and third degree burns.

Eat and Drink in Fallout Area. Only food and water that has been stored in sealed containers should be eaten. Before the containers are opened, any fallout should be washed or brushed off, the containers should then be monitored.

Food in open containers should not be eaten because it is likely to be contaminated. Fruits and vegetables with tough skins, however, can be eaten if they can be washed well, if the skin can be removed, and if the remaining portion is monitored.

Clean water is to be provided by the Supply and Service Unit. However, if no uncontaminated water is available, contaminated water can be filtered through a column of earth and used sparingly until clean water is provided.

React When Given Warning. When warned of an impending friendly nuclear attack, units can make defensive preparations that will lessen casualties.

Prepare Shelter. The best defense against nuclear attack is to dig in. Unit defensive positions, which vary from individual foxholes to improved defensive positions, should be prepared whenever the tactical situation permits.

Certain common materials and types of construction will provide good shielding against gamma radiation and neutrons, and will provide protection against the blast and heat of a nuclear detonation. Foxholes, natural and man-made shelters, vehicles, and buildings provide defense against nuclear weapons.

Foxholes. A properly constructed foxhole offers excellent protection against both initial and residual radiation, because dirt is a good shielding material. A deep foxhole gives more protection than a shallow one because of the greater thickness of the shielding material, and the greater reduction of the initial radiation entering the hole. An overhead covering of earth or other material will reduce the amount of thermal and initial nuclear radiation that reaches the individual and will also prevent the entrance of fallout.

This cover must be sturdily constructed to withstand the blast wave.

Field Shelters. Well-constructed fighting positions and bunkers provide excellent protection against all the effects of a nuclear detonation. Tunnels, caves, and storm drains also provide good shelter unless there is a nearby subsurface collapse of these shelters. Culverts and ditches can be used in an emergency, although they offer only partial protection.

Vehicles. Tanks provide good protection in most situations. Lightly armored vehicles such as the armored personnel carriers, also give some protection, but foxholes offer greater protection. All armored vehicles should be buttoned up.

Buildings. Buildings usually are not strong enough to provide effective shelter, but the lowest floor or basement of a reinforced concrete or steel-framed building will offer good protection from all effects, except the blast overpressure, if personnel avoid the areas around windows and other openings.

Prepare Supplies and Equipment. Clothing, supplies, and equipment must be secured to prevent them from being blown about by the blast wave and to reduce the fire hazard resulting from the intense heat of the explosion.

Clothing, equipment, and other items issued to individuals should be kept in their foxholes, if possible, or in a separate, covered hole. The helmet, weapon, and any individual equipment not being worn should also be placed in the foxhole. None of this equipment can be left unsecured because the blast wave will convert them into lethal missiles.

Objects such as radios, generators, tools, and gas cans are always secured to minimize the danger of casualties from flying debris caused by the blast wave.

Unit supplies, particularly explosives and flammables, should be dispersed within the unit area and protected or shielded. Debris must be kept to a minimum and not be allowed to collect where a fire hazard would be created.

Food and water supplies should be secured in sealed containers.

Prepare Electronics Equipment for Electromagnetic Pulse (EMP). Any electronics or communication equipment that is not immediately needed should be turned off or disconnected from power sources. Antennas also should be removed and cables disconnected from the equipment.

Procedures During and After the Attacks

Procedures followed by units during and after the attack are the same as procedures for an attack that occurs without warning. Soldiers perform self-aid and first aid measures, where necessary, prepare for fallout, and continue the mission as directed.

FIRST-AID AND TREATMENT OF CASUALTIES

The casualty-producing effects of a nuclear explosion are blast, thermal radiation, and nuclear radiation. First aid measures are usually limited to treatment for burns caused by thermal radiation and injuries caused by the blast wave. NO immediate lifesaving measures are available for the treatment of radiation sickness or blindness caused by the intense light.

Blast injuries

Injuries caused by the blast wave which are treatable with first aid measures are usually associated with either the impact of missiles or the physical displacement of the body. The damage caused can range from minor cuts and bruises to broken bones, severe lacerations, and critical damage to vital organs. In all these cases, however, the first aid treatment which is given is the same as that which would be used for any accident victim or conventional combat casualty suffering similar injuries. Detailed procedures for the first aid treatment of specific types of injuries are given in FM 21-11.

There are two types of blast effects.

Direct blast. An effect which starts as the blast wave moves towards you and causes an overpressure. Although our bodies can withstand a lot of overpressure, 8 psi (pounds per square inch) can rupture ear drums, 45 to 55 psi will cause 50% fatalities due to lung and circulatory collapse, and 55-65 psi brings the probability of death to 99% of personnel.

Indirect blast. Injuries result from buildings collapsing, glass, pieces of metal, wood, rocks, etc., being thrown about by the winds following the blast wave. In addition, these winds can pick up an individual and hurl his/her body forcibly against solid objects.

Thermal radiation injuries

The intense heat generated by a nuclear detonation can cause burn injuries directly, by the absorption of the radiant energy by the skin, or indirectly, as the result of fires started by the thermal radiation. The direct burns are often referred to as "flash burns," since they are produced by the flash of thermal radiation from the fireball. The indirect burns are called "flame burn"; they are identical to skin burns caused by any fire. Burns are generally classified according to their severity, in terms of the degree of the injury.

It has been estimated that thermal effects (burns) were responsible for more than 1/2 of the deaths and about 3/4 of all the casualties at Hiroshima and Nagasaki; 150,000 people received burn injuries and of this number 50,000 died.

The three degrees of burns to the body or skin are:

- 1st degree burn - redness of skin equivalent to a sunburn.
- 2d degree burn - equivalent to a severe sunburn with blisters.
- 3d degree burn - charring of the flesh.

First degree burns, sunburn for example, causes only redness of the skin. Healing normally occurs without special treatment and no scar formation is left.

Second-degree burns are deeper and more severe, and are characterized by the formation of blisters. Severe sunburn with blistering is an example of a second-degree burn.

In third-degree burns, the full thickness of the skin is destroyed. Unless skin grafting techniques are employed, there will be scar formation at the site of the injury. The depth of the burn is not the only factor in determining its effect on an individual. The amount of skin area which has been affected is also important.

Thus, a first-degree burn over the entire body may be more serious than a third-degree burn at one small spot. The larger the area burned, the more likely is the appearance of symptoms involving the whole body. Furthermore, there are certain local regions, such as the hands, where most any degree of burn will incapacitate the individual. All burns, however, are treated similarly, as determined by the degree of body coverage, regardless of what caused the burns. The details of first-aid treatment for different degrees of burns are covered in FM 21-11.

Every effort must be made to ensure the number of burn casualties are as few as possible. The material and personnel required in the treatment of one casualty with a 40% coverage of 3d degree burns, according to present standards is:

- 42 tanks of oxygen
- 36 pints of plasma
- 40 pints of blood
- 104 pints of fluids
- 2.7 miles of gauze
- 3 nurses
- 2 physicians
- Great quantities of drugs

The effects of the "light portion" of thermal radiation on the eyes fall into two main categories: Temporary blindness, and permanent blindness. Concentration of sufficient direct thermal energy, due to the focusing action of the eye lens, can cause the permanent blindness. This focusing occurs, however, only if the fireball is in the field of vision of the individual. When this happens, the damage may be experienced at distances from the explosion which even exceeds those at which the thermal radiation will cause skin burns.

Temporary blindness can occur in the individuals who are too far from the detonation to suffer permanent injury or who do not view the fireball directly. This blindness results when more thermal energy is received by the retina than is necessary for image perception, but less than is required for burns. The effect is a localized bleaching of the visual elements, with image persistence, after-image formation, halo, etc. A few seconds to several days may be required for the eye to fully recover its functions. Temporary blindness occurs at greater ranges at night, when the eye is adapted to the dark, than in daylight; however, the range of these effects is highly dependent on the prevailing atmospheric conditions at the time of burst.

Flash blindness is normally a temporary condition caused by the brilliant flash produced by a nuclear explosion (many times brighter than the sun). It is not necessary for one to look at the fireball to develop the condition. It can be reflected from the sky, ground, and other objects. This effect should not last more than a few minutes during daylight but can last from a few minutes to many hours during the night when the pupils are dilated. Therefore, flash blindness can reduce combat effectiveness.

No matter what the degree of blindness, no first aid treatment is necessary. Individuals suffering permanent damage can only be made as comfortable as possible and evacuated. Individuals who are temporarily blinded will recover unaided with the passage of time, but may require some assistance in taking care of themselves until their sight returns.

Retinal burns (eye burns) are more serious and are produced by looking at the fireball. This effect can happen at such great distance from the explosion that thermal radiation will not produce a skin burn. This effect is also likely to occur at night and more likely to occur when using a telescope or binoculars. Eye burns may leave permanent scarring and interfere with vision.

Nuclear radiation injuries

The exposure of the human body to nuclear radiation causes damage to the cells which are the basic structural components of all parts of the body. This damage is the cause of what is generally called "radiation sickness," the severity of which depends on the radiation dose received. After the individual is exposed, the early symptoms of radiation sickness will appear, usually after a delay of from 1 to 6 hours. These symptoms may include headache, nausea, vomiting, and diarrhea. These early symptoms may then be followed by a latent period during which the symptoms disappear. There are no first aid measures which will help a person who has been exposed to nuclear radiation other than making him as comfortable as possible as he is undergoing the early symptoms.

If the radiation dose was relatively small, the symptoms, if any, will probably go away and not recur. If the symptoms continue or recur after a latent period, the casualty should be sent to medical treatment facilities.

The response of an individual to nuclear radiation depends upon several factors, some of which are dose, portion of body exposed, duration exposed, prior exposure, and individual variation (physical make-up). First we take up dose. Listed below is a rough guide in predicting the effects of wholebody radiation. (Numbers are in wholebody total dose.)

200 cGy(rad)-sickness for approximately 5% of personnel.
500 cGy(rad)-Lethal for approximately 50% of personnel.
1000 cGy(rad)-Lethal for almost all personnel.

During the average life time, every human being receives a total of about 10 cGy(rads) (or more) of nuclear radiation over the whole body from natural sources.

Area (whole body or localized)

The injury caused by a certain dose of radiation will depend upon the extent and part of the body that is exposed. Acute exposed dose of 700 cGy(rads) applied to a small region of the body may not result in considerable damage. If whole body is exposed many organs are affected and recovery is more difficult.

We can expose a tumor to a dose of 4,000 cGy(rads) of X-Ray radiation. This amount is needed to kill the tumor. This dose might even be repeated after a time, without killing a man. However, the same dose to the whole body would readily kill the individual.

Time (acute and chronic). The effects of nuclear radiation on people depend not only on the total dose received but also the rate at which it is received. 1,000 cGy(rads) received within a 24 hour period would be fatal if the whole body was exposed, but it would probably not cause death if received more than less evenly over a period of 30 years. When absorption is over a period of time, damage cells are replaced by new cells by natural recovery. When a large dose is received in a short time, recovery cannot keep pace with the damage.

Previous exposure. The damage caused by radiation is cumulative within the body. Refer to FM 3-3 for your operation exposure guide.

Individual variation. There is a variation in degree of resistance seen in different cells, tissues and organs. Extremes of age, (i.e., the very young and old), are physical conditions of considerable importance. Young adults can take radiation better than older adults. The older one gets the less rapidly the repair system works.

PHASES OF RADIATION SICKNESS

Initial Phase

- a. Several hundred (200-300) cGy(rads) received in less than 1 hour - no immediate reaction.
- b. After exposure - normal state for 1 to 2 hours, suddenly listless and fatigued, patient becomes quiet, withdrawn, and antisocial.
- c. Five to 8 hours after exposure - upset stomach and loss of appetite, followed by vomiting.
- d. Third day - patient feels well.

Latent Phase

- a. 3d to 20th day - patient feels well, can work.
- b. 13th to 17th day - loss of hair.
- c. 20th to 21st day - symptoms erupt again.

Toxic Phase (Bone marrow depression). The casualty experiences:

- a. Feverish feeling
- b. Headache
- c. Fatigue
- d. Difficulty in breathing
- e. Short time confined to bed

Recovery Phase (8 to 14 weeks after exposure). Provided the individual receives:

- a. Rest
- b. Good food
- c. Vitamins
- d. Iron

Treatment of radiation sickness

Our body has the ability to self repair unless extensive damage has been done. Since we cannot halt the actions of radioactivity, the treatment of casualties will be symptomatic. Treatment will be:

- a. Rest
- b. Fluids
- c. Personal hygiene
- d. Antibodies

PREPARE AND SUBMIT NBC 1 (NUCLEAR) REPORT

CONDITIONS

Given: A watch, compass, map, pencil, paper, and format for an NBC 1 (Nuclear) report. An NBC attack has just occurred.

STANDARDS

In 5 minutes, submit an NBC 1 (Nuclear) report, reporting as a minimum, lines D, H, and either B and C or F. NOTE: the other lines may be used as required by the situation and the availability of the information.

PERFORMANCE MEASURES

I. Initial NBC 1 (Nuclear).

a. Measure the time from the "flash" to the "bang." You may use a watch or count slowly 1,000 and one, 1,000 and two, etc.

b. Write down the number of seconds as line J.

c. Write down the time on your watch as line D. Note whether it is local or ZULU time.

d. Write down the type of burst as line H. This should be recorded as "Surface," "Air," or "Unknown."

(1) Surface - if you can see a crater or a thick dense stem from the cloud to the earth.

(2) Air - if you can see that the stem is not connected to the mushroom part of the cloud.

(3) Unknown - if you do not know.

20. If you can see the crater, use your map to find out its coordinates. Write down the coordinates as line F.

f. If you cannot see the crater, use your compass to determine the azimuth to the center of the mushroom cloud. Write down the azimuth as line C.

g. Write down your location as line B.

h. Give or send the report to your supervisor. If the report must be transmitted, give it a "Flash" precedence.

2. Subsequent NBC I (Nuclear).

a. Measure the angular cloud width 5 minutes after the burst. Write down the angle as line L. The following items can be used to measure the angle:

(1) Aiming Circle.

(2) BC Scope.

(3) Theodolite.

(4) Compass.

b. Measure the verticle angle from the ground to the top or bottom of the cloud 10 minutes after the burst. Write down the angle as line M. Also write down which was measured, top or bottom.

c. Add line L or M to your initial NBC I. Send or give the entire message to your supervisor. If the report must be transmitted, give it an "Immediate" precedence.

REFERENCE

FM 21-3, Task 031-503-3005

PROCESS AN INITIAL NBC 1 (NUCLEAR) REPORT

The doctrine of the Threat nations places great emphasis on the depth, intensity, and destructiveness of the initial nuclear strike. This initial massive attack is viewed as a means to gain surprise, achieve a major penetration, and destroy effective resistance. The objectives and depth of intended operations will dictate the types, yields, and numbers of nuclear warheads employed, but recent Threat studies indicate that nuclear weapons, if employed, will become their primary means of destroying US forces. The wide range of nuclear delivery systems available to Threat forces will extend the battlefield to the rearmost boundaries of the theater. These systems include short and medium range ballistic missiles, rockets, aircraft, and field artillery and can deliver warheads with yields ranging from sub-kiloton to multimegaton. The first priority for Threat nuclear strikes will be US units with nuclear delivery capabilities. Other targets high on the priority list will be command posts, communications centers, and nuclear munitions storage areas.

The United States policy on the use of weapons is:

"US use of these weapons will be considered only after all conventional means of warfare have been severely tested and found inadequate, or in response to the Threat's first-use."

The approval for our initial use of nuclear weapons must come from the President of the United States. This is accomplished through a complex message system requiring a specific action at each level of command.

With Threat forces doctrine and capability in mind, it is easy to visualize the importance placed on the initial report converting a conventional battlefield into a nuclear battlefield.

This "first use" report, which will probably be initiated at small unit level, must be communicated without delay, through the chain of command to the Theater Commander who will then communicate with the Army Chief of Staff. The Chief of Staff will then communicate through channels until eventually the President is notified. If a decision to retaliate is made, the authority must return through basically the same channels, therefore, time will be extremely critical. A FLASH precedence will be used by all levels of command in forwarding the first use report. It cannot be emphasized enough that at no level will this report be delayed. Immediately upon receipt, it should be retransmitted to the next higher headquarters.

DESIGNATED OBSERVER SYSTEM

It is unlikely that any unit will be in a position to obtain all the nuclear burst data. Units should gather as much data as possible. Although all units must know to gather and use observed data, not all units should submit reports. A unit must know when it is required to report. A designated observer reporting system determines which observing units will report data to higher headquarters. Designated observer reporting units not only gather data for their own direct use but also report through specified channels for command-wide use. All data is reported to and evaluated by the Nuclear, Biological, and Chemical Center (NBCC) in the division Tactical Operations Center (TOC). The evaluated data is returned to the field in various informational and instructional reports.

Equally as important as unit knowing when it is required to report, is that a unit know when it is NOT to report. The nondesignated observer units gather information for their own use. Unnecessary reporting hinders the flow of information, overloads communications channel causing serious disruption to other necessary command communications, survival, and mission accomplishment. Without management, data of various degrees of reliability are sent to the NBCC. Less reliable information competes with much better data.

The success of a command in rapidly gathering accurate data about enemy nuclear attacks is directly related to the ability to organize the flow of data. Management is the key. The NBCC has the responsibility to keep all units informed on attacks using the collected data. The NBCC directs the entire effort, changing, and modifying tactical information before an attack as needed.

This section discusses the design and arrangement of a designated observer system. Guidance is provided to individuals, unit NBC defense team, and the NBCC.

The system applies only to reports about enemy nuclear attacks, NOT chemical or biological. Only designated observers are needed for nuclear reporting because nuclear attacks are widely visible whereas chemical and biological attacks are not. Observers can be eliminated in the Nuclear Reporting System where there are many who can see and report. In the biological/chemical areas, where there are few who would know of localized attacks, observers must report. The system described herein is used by all levels of command down to and including company, battery, and troop level.

The designated observer system provides the essential data for the preparation of radiological hazard location predictions and nuclear assessments. The system provides raw observer data using a standard report format. The Division Field SOP specifies the precedence the message will have, as well as the primary and alternate means of communication. Most of the time, only the first nuclear burst in theater needs to be reported with FLASH precedence. Designated observers are selected to provide total coverage of the entire area of operations/interest. This coverage requires a judicious selection of ground and aerial observers from the units located within or overlooking the area according to capabilities, mission, and expected survivability. It should be noted that an observer is a unit, not a person. Unit commanders determine the methods of gathering data within their units according to the training and organization of their NBC Defense Teams.

Selection of ground units for the designated observer reporting system is based on many factors. Some of these factors are as follows:

- Battlefield location
- Organic angle-measuring equipment
- Communications nets available
- Mission (current and future) interference
- Expected enemy action (routes) and targeting (friendly vulnerability analysis)
- Training and experience
- Inherent reliability of unit personnel

Field artillery or air defense artillery units are normally designated as opposed to units assigned on attack missions or other units like military police or transportation. These artillery units are usually the best-qualified units for observer designation because of their equipment capabilities. These units possess organic angle-measuring equipment which is ideal for nuclear burst surveillance. The equipment is in constant use, making a high level of training and reliability of measurements inevitable. The equipment items are listed in order of preference as follows:

- Aiming Circle, M2
- Battery Command (BC) Scopes, M65 or M43
- Theodolites, T16 or T2
- Pocket Transit; Compass, M2

In choosing designated ground observers, select unit with this equipment.

Any other type of unit (such as a mortar platoon) which has this or similar quality equipment may also be considered for observer designation. One additional type of equipment which should be considered is radar. Many radar devices have the capability to depict a nuclear cloud on their scopes. Air defense artillery radar, direct coordination should be made with units possessing the radar. The NBCC should also coordinate with all units having photographic capabilities. These units should photograph all nuclear attack clouds and the damage caused by the attack, if possible. This intelligence is invaluable in post strike analysis, damage assessment, and recovery operations. The knowledge is also needed for comparison of yield estimation field procedures to actual results. Any film or photographs of an attack are provided to the G2.

NUCLEAR BURST OBSERVER'S REPORT (NBC 1)

The nuclear burst observer's report, the NBC 1, is used to report enemy nuclear strike data determined by designated observer reporting units to the NBCC. The NBC 1 report is not used for friendly strikes. Advanced warning of friendly strikes is provided in the STRIKWARN/NUCWARN. The NBC 1 report format conforms to North Atlantic Treaty Organization Standardization Agreement (NATO STANAG) 2103/ATP45. Only the portion of STANAG 2103/ATP45 concerning the NBC 1 nuclear report format is shown here. Using the NBC 1 format, data from designated observer reporting units can be sent rapidly and briefly, to the NBCC. The NBC 1 report is not used as attack notification. It does not serve any purpose in nuclear release procedures or authentication systems. The primary purpose of the NBC 1 report is to send nuclear burst data from the designated observer reporting unit to the evaluating headquarters. The report may also be used to provide data from one NBCC to another. NBC 1 reports are not routinely passed to corp or higher NBCC. Precedence of the NBC 1 is determined by the NBCC and follows procedures included in the Division Field SOP.

The line items of the NBC 1 report are explained below.

<u>LINE ITEM</u>	<u>MEANING</u>
ALFA	Strike serial Number (if known). The strike serial number is assigned by the NBCC at the division tactical operations center responsible for the area where the attack occurs. Target numbers may be used for friendly attacks.
BRAVO	Position of the observer UTM or place. If the place name is given, the center of that place is assumed as the plotted location of GZ. Data must be encrypted or sent secure (OPSEC considerations, not specifically NBC.) This line is required on all reports from ground observers.

CHARLIE Direction measured clockwise from grid, true, or magnetic North of the attack from observer (state which). Report in mils or degrees (state which). This line is not required when FOXTROT (actual) is reported.

DELTA Date and time of detonation. Report as ZULU or local (state which).

FOXTROT When ACTUAL ground zero location is reported, line item CHARLIE may then be omitted.

GOLF Means of delivery, if known.

HOTEL Type of burst -- air, surface, or unknown (state which). Include height of burst, if known. This line item must always be reported.

JULIET Flash-to-bang time (in seconds).

KILO Crater present or absent. Include diameter (in meters), if known.

LIMA Nuclear burst angular cloud width measured at 5 minutes after burst (H + 5). Report in mils or degrees (state which). Do not report if data are obtained more than 5 minutes after burst.

MIKE Stabilized cloud-top angle and/or cloud-bottom angle (state which) or cloud-top height and/or cloud-bottom height (state which). Measure at H + 10 minutes. Report in mils, degrees, meters, or feet (state which).

PAPA For radar purpose only. Reported as PA or PB (see below):

PAPA BRAVO--Effective downwind direction (direction the wind is blowing). Report in degrees or mils (state which).

Reporting Formatting Instructions

NBC I reports are formatted by unit NBC defense teams. This procedure ensures that the content of the report is known to the commander or commander's representative. The procedure also assures the report meets format instructions from higher headquarters and is correct.

Selected individuals identified by unit SOP submit raw data to the unit NBC defense team. The unit SOP also includes specific observations to be made. These identified individuals need not use the NBC I report format or individual line items of the Nuclear, Biological, and Chemical Warning and Reporting System (NBCWRS) to pass their data to the NBC Defense team, as this will be done by them. The NBC defense team determines the date/time of attack, flash-to-bang time, illumination time, means of delivery, and type of burst. Data on azimuth to attack from the observer, observer location, and cloud width at H + 5 minutes or cloud-top/bottom angle at H + 10 minutes are determined by persons qualified to operate the unit's organic measuring equipment. If special angle measuring equipment is not available in the unit, some measurements can be taken carefully using the lensatic compass (azimuth to the attack) and binoculars (cloud width).

Data are reported over internal radio or wire nets, presented in person, or even shouted from one location to another. The NBC I report format is not required under these circumstances. If there are any questions concerning the reported data, they are resolved at this time.

The unit NBC Defense team puts raw data into the NBC I format for transmission. All data observations are sent in a single, complete NBC report. Data will not intentionally be divided into two reports (for example: an initial and subsequent or follow-up reports). Normal reaction to stress of nuclear warfare and personal survival of a burst should allow time for collection of data, which will probably result in one report being sufficient. However, additional reports can be sent if necessary, such as new data concerning actual GZ location or the presence/absence of a crater. Sending all available data in one report is desirable, to reduce the number of reports. This procedure ensures the best reports receive first consideration at the NBCC. Electromagnetic pulse (EMP), blackout, and an active enemy, electronic warfare (EW) threat will also take a toll on our communications systems.

Individual units may have forms or worksheets to be used when recording NBC I reports. See the individual unit SOP for details on specific unit use. The use of these forms is not normally required when equipment operations and unit NBC defense team personnel are well trained. Units that use these forms or worksheets must ensure that the form design does not hamper or restrict collection or reporting data. Remember, these aids cannot substitute for proper training.

Special Instructions

All reports from ground observers must contain line items BRAVO and CHARLIE or BRAVO and FOXTROT.

Line item MIKE data is measured and transmitted only when data for line item LIMA cannot be determined.

Transmit only those line items of the format for which data are available. The word UNKNOWN is used only with line item HOTEL.

Nuclear Burst Report Precedence

The NBCC will provide guidance on the precedence of an NBC I report in the Division Field SOP on the designated observer reporting system. This guidance should be based on intelligence estimates, historical use of nuclear weapons by the enemy, effect on evaluation and warnings if report is delayed, communication nets, and other local factors. No direct statement on precedence for an NBC I is given here. Any precedence (flash, immediate, priority, or routine) can be used according to the need for the information. Normally, FLASH precedence is used for the first burst reported in the theater (or for what is perceived as the first burst). Once all units are aware of the change from conventional to special weapons or because of the density of use, the procedure may be reduced on future reports.

Communication Means

The NBCC will specify to designated observers which communication means (nets) are to be used for NBC I reports. Secondary and tertiary methods are also identified. The NBCC must coordinate with the signal officer and each "owner" of the nets. Intermediate headquarters do not delay the transmission of NBC I reports from designated observer reporting units.

Example Nuclear Burst Observer Reports (NBC I)

The example nuclear burst observer report shown in this section follow the NBC I format and reporting instructions. All observer locations are encoded to simulate clear text transmissions. The example does not limit the variety of reports. Further, users of the NBC I are not confined solely to the use of the line items in the example. Other line items may be added at the user's discretion.

PRECEDENCE (IAW Unit SOP)

DATE/TIME OF MESSAGE (Time zone IAW SOP or OPORD/OPLAN)

SECURITY CLASSIFICATION (IAW SOP, usually unclassified)

FROM

TO

TYPE OF REPORT

EXAMPLE: Report sent by a designated observer reporting unit

PRECEDENCE (IAW SOP)

101200 ZULU

UNCLASSIFIED

FROM R2F69

TO H7B85

NBC I NUCLEAR

BRAVO

CHARLIE

DELTA

HOTEL

JULIET

LIMA

ROMEO ALFA GOLF HOTEL MIKE XRAY LIMA KILO ECHO ALFA

190 MILS GRID

101145 ZULU

SURFACE

60

445 MILS

Nuclear Burst Cloud Measurements

Measurements of the nuclear burst cloud are taken at H + 5 minutes or H + 10 minutes. A designated observer reporting unit possessing organic angle-measuring equipment will take measurements and report the results to the unit NBC defense team. The team formats the results into an NBC 1 report. The report is sent over the specified communication nets with pre-established precedence. If the unit is not a designated observer, it will still construct the report for its own use. The unit will not send the report unless specifically asked to do so by the NBCC.

Input data for yield estimation are determined at unit level by specifically appointed and trained individuals. These individuals operate the organic optical angle-measuring equipment. Unit SOPs detail the duties and circumstances concerning when and how measurements are to be taken.

From the standpoint of accuracy, a list of measurements to aid in SOP development (in order of decreasing reliability) is provided as follows:

- Nuclear burst angular cloud width at H + 5 minutes
- Stabilized cloud-top or bottom height at H + 10 minutes
- Stabilized cloud-top or bottom angle at H + 10 minutes

Nuclear Burst Angular Cloud Width

Width of the nuclear burst cloud is the angular dimension in mils or degrees of the nuclear burst cloud diameter. This measurement, made at H + 5 minutes, is taken by the optical equipment operator. Specifically, the operator will measure the azimuth by reading the degrees from each side of the cloud. This procedure will be referred to when taught in the classroom or in the field by, "assign an azimuth to the left side of the cloud and an azimuth to the right side of the cloud." The difference between the numerical values of these azimuths is the angular cloud width. This measurement is made for nuclear clouds resulting from air or surface bursts.

All units have some ability to take this measurement. The preferred measuring instrument is the lensatic compass if optical angle-measuring equipment is not available. The optical angle measuring equipment is the most accurate. Binoculars and similar visual aids are the least accurate.

Stabilized Cloud-Bottom or Cloud-top Angle

The cloud-bottom angle measurement is the vertical angle in mils or degrees measured from ground zero level (or ground level if ground zero level is not discernible) to the point of intersection of the stabilized cloud and the stem. Measurement is made at H + 10 minutes.

The cloud-top angle measurement is a vertical angle in mils or degrees measured from ground zero level (or ground level) to the top (or tangent) of the stabilized cloud. This measurement is made at H + 10 minutes.

Cloud-bottom and cloud-top angle measurements have less inherent reliability than cloud width measured at H + 5 minutes. Cloud-bottom or top angle measurements are not taken for air bursts. Most units in the field cannot take cloud-bottom or cloud-top angle measurements; therefore, these field units are not normally designated as observer reporting units. The lensatic compass is not capable of this measurement. The BC Periscope will make these measurements, as well as measure cloud width.

Equipment Operators Procedures

Determine the observer position -- UTM coordinates or place name. This location is entered as line item BRAVO. Line item BRAVO is required on all reports from ground observers.

If ground zero cannot be observed, measure the azimuth from observer to the center of the stem or nuclear burst cloud. This datum is entered as line item CHARLIE. If ground zero can be observed, determine the UTM coordinates or place name and enter as line item FOXTROT (actual). Line item CHARLIE is then omitted.

Measure the angular width of the cloud 5 minutes after the detonation. This data is entered as line item LIMA. If the angular width cannot be measured, designated observer units measure the cloud-bottom or cloud-top angle at 10 minutes after the detonation. Nondesignated units with angle-measuring equipment can also take this measurement for their own use. This datum is entered as line item MIKE.

During hours of darkness or poor visibility, the procedures below should be followed.

Drop to the ground at the flash, and estimate the duration of illumination by counting as previously described. Continue counting until you hear the bang (arrival of the blast wave) for the flash-to-bang time. Enter illumination time as line item ECHO and flash-to-bang time as line item JULIET.

If possible, measure the azimuth to the stem of the nuclear burst cloud as soon as possible. This datum is entered as line item CHARLIE.

Enter datum for line items BRAVO, DELTA, and HOTEL.

The individual specifically tasked to take cloud measurements report this data and other data specified in the SOP to the unit NBC defense team. If the unit is a designated observer reporting unit, the team will format the data into an NBC 1 report. The report is transmitted per SOP to the NBCC. If the unit is not a designated observer, the same procedures apply, except the report is not sent but is kept for the unit's own internal use.

Each unit, designated and nondesignated, uses the data to locate GZ and estimate the yield. GZ and yield are used to make a simplified fallout prediction. This prediction is used until the NBC 2 report is received. The NBC 2 report provides more accurate ground zero and yield data. Therefore, the simplified prediction is then remade. Receipt of an NBC 3 (Detailed Fallout Prediction) report supercedes all simplified predictions.

Operators of the angle-measuring equipment should be extensively trained in their nuclear cloud surveillance duties.

The SOP must provide clear instructions concerning which measurements are to be taken, who is to take them, how they are to be taken, when they are to be taken, and how these and other data are to be reported to the unit NBC defense team.

PREPARE SIMPLIFIED FALLOUT PREDICTION

CONDITIONS

You are in a field environment. The area in which you are located has been designated as a tactical operation center (TOC). You are given an NBC 2 (Nuclear) report; a current effective Downwind Message (EDM); GTA 3-6-3; a map; an area predictor, radiological fallout, MSA2, NSN 6665-00-106-9595; a grease pencil; a hairline or straightedge; a compass; and a protractor.

STANDARDS

±1. Ground zero (GZ) is determined and plotted on the map within ± 200 meters.

2. The correct EDM line is selected.

NOTE: If the EDM line consists of three digits, steps 3-6 are completed.
If the EDM line consists of six or eight digits, steps 7-15 are completed.

3. A circle with a radius equivalent to the EDM line is drawn around GZ on the predictor within ± 200 meters and labeled as ZONE I.

4. A circle with a radius twice the size of ZONE I is drawn with ± 200 meters on the predictor and labeled as ZONE II.

5. Marginal information, including date/time of attack, location of GZ, and scale of predictor, is entered on the predictor.

6. GZ on the predictor is placed over the GZ coordinates on the map.

7. The correct cloud radius semicircle is selected.

NOTE: Step 8 is performed only if the EDM line consists of nine digits.

8. The pre-printed radial lines are expanded equally on each side to the total degrees of the EDM line within ± 2 degrees.

9. The downwind distance of ZONE I is determined, marked on the predictor within ± 200 meters and labeled as ZONE I.

10. The ZONE I distance is doubled, marked on the predictor within + 200 meters, and labeled as ZONE II.
11. Tangent lines are drawn on the predictor from the cloud radius semicircle to the intersection of ZONE I with predictor radial lines.
12. Time-of-arrival arcs, $H + 1$ and $H + 2$, are drawn on the predictor within ± 200 meters and labeled.
13. Marginal information including time of burst and location of GZ is written on the predictor.
14. Grid north (GN) is determined, marked within ± 2 degree on the predictor, and labeled as GN.
15. The predictor is placed over the map and oriented.

PERFORMANCE MEASURES

1. Locates GZ.
 - a. Determines GZ location from line FOXTROT of NBC 2 report.
 - b. Plots location of GZ on map.
2. Selects appropriate EDM line.
 - a. Determines weapon yield from line NOVEMBER of NBC 2 report.
 - b. Uses yield to determine line on GTA 3-6-3.

NOTE: If the EDM line consists of three digits, measures 3-6 are completed. If the EDM line consists of six or nine digits, measures 7-15 are completed.

3. Draws and labels ZONE I circle.
 - a. Determines radius of ZONE I circle from three digit EDM line.
 - b. Draws circle around GZ on predictor.
 - c. Labels circle as ZONE I.
4. Draws and labels ZONE II.
 - a. Determines radius of ZONE II circle by doubling the radius of ZONE I.
 - b. Draws ZONE II circle around GZ and ZONE I.
 - c. Labels circle as ZONE II.

5. Enters marginal information on predictor.
 - a. Includes date/time of attack.
 - b. Includes location of GZ.
 - c. Includes scale of predictor.
 6. Places GZ on the predictor over the GZ coordinates ~~on~~ the map.
 7. Selects the cloud radius semicircle on the predictor that corresponds with the EDM line.
- NOTE: Performance measure 8 is performed only if the EDM line consists of nine digits.
8. Expands per-printed radial lines.
 - a. Determines total degrees of expansion from last two digits of EDM line.
 - b. Expands lines equally to total degree stated.
 9. Marks and labels ZONE I.
 - a. Determines the effective wind speed from the EDM line.
 - b. Uses wind speed and yield to find downwind distance of ZONE I on nomogram located on predictor.
 10. Marks and labels ZONE II.
 - a. Determines ZONE II distance by doubling the distance of ZONE I.
 - b. Marks ZONE II on predictor with solid arc.
 - c. Labels area as ZONE II.
 11. Draws tangent lines on predictor.
 - a. Begins lines at cloud radius semicircle ends.
 - b. Extends lines to ZONE I distance intersection with predictor radial lines.

2. Draws time-of-arrival arcs on predictor.
 - a. Determines effective wind speed from EDM line.
 - b. Draws dashed arc equivalent to wind speed.
 - c. Labels arc area as H + 1.
 - d. Doubles H + 1 arc distance.
 - e. Draws dashed arc at doubled H + 1 distance.
 - f. Labels arc area as H + 2.
3. Enters marginal information in predictor.
 - a. Includes time-of-burst.
 - b. Includes location of GZ.
4. Marks and labels GN on predictor.
 - a. Determines effective downwind direction from EDM line.
 - b. Locates direction on azimuth dial of predictor.
 - c. Draws a line from GZ through the direction on dial.
 - d. Label as GN.
5. Orients predictor to map.
 - a. Determines map and predictor scales to be the same.
 - b. Places GZ of predictor over GZ coordinates on map.
 - c. Rotates predictor until GN line on predictor points toward GN on map.

REFERENCE

M 3-22

EVALUATION OF NUCLEAR BURST DATA

Data Evaluation

Data evaluation consists of locating ground zero and estimating yield. This evaluation is performed at two levels, unit and NBC Collection Center (NBCC). Unit level is any level other than NBC Collection Center. The distinction is made between the two levels because of the data and the personnel available to make an evaluation of ground zero and yield.

Unit level techniques are designed to provide rapid evaluation. All estimations of GZ location or yield developed at unit level are interim data. They are used only at this level. Unit level data are never transmitted to higher headquarters or the NBCC in the NBC 2 report format.

NBCC level techniques are based on the comparison of data from many sources. Because of the availability of sufficient, diverse, reliable reports and a sufficient staff to perform calculations, only the NBCC develops the NBC 2 report. The NBC 2 report contains the yield and GZ location to be used by the entire command. This report also contains other useful data.

Unit Level Procedures

Unit level procedures for locating GZ and estimating yield are much less complicated than NBCC level procedures. Unit level is defined as any level that does not have an organic NBCC. At unit level emphasis is placed on speed of the calculation rather than accuracy. The NBC 2 report is usually relied on, but it may not be received from the NBCC because reporting is heavily dependent on radio nets. The integrated battlefield and electro-magnetic pulse (EMP) will pose serious communication problems to use these nets. Additional problems will be caused by unit dispersion which is essential for survival. Other problems will be caused by requirement to change frequencies and call signs several times daily. All these problems, coupled with an aggressive enemy electronic warfare program, will delay message traffic. The "unit" level cannot produce an NBC 2 because this level has neither the diverse reliable data necessary nor the staff and materials to make the calculations. However, an independent means of calculation is used until the official NBC 2 report data reaches this level. This independent means is discussed in this section.

The procedures in this section apply to all units whether they be designated as reporting observers or not. All units follow these procedures to get immediate information for their own quick tactical planning. These procedures are usually not used at NBCC level where more data are available.

Location of Ground Zero

At unit level, GZ is located in a one of two ways. For small yield weapons, direct observation may provide actual GZ location. Units do not reconnoiter for the GZ location. Polar plot is the other GZ location method used at unit level. Commanders at unit level are interested in obtaining a "gross fix" on GZ location. One of these methods will enable rapid evaluation of the burst to estimate the situation. The NBC defense team does the calculations.

Methods of Locating GZ

Using the reported information, the location of GZ can be determined by several different methods. GZ will normally be determined by the intersection of azimuths from two or more observation points reporting on the same nuclear burst. Other methods also can be used. The different methods of locating GZ are:

- Intersection of two azimuths
- Intersection of more than two azimuths
- One observer location with azimuth and flash-to-bang distance
- Intersection of two flash-to-bang distances
- Intersection of an azimuth and a flash-to-bang distance

Intersection of two azimuths. To determine the location of GZ using this method, the position of the observers and the azimuths from their position are plotted on the situation map. GZ is determined to be the point of the map where the two azimuths intersect.

EXAMPLE: Observer A's position is reported as coordinates 105240 with an azimuth to the nuclear cloud of 35° Grid. Observer B, located at coordinates 157220, reported a measured azimuth of 340° Grid. To determine the location of ground zero, follow the step-by-step procedures.

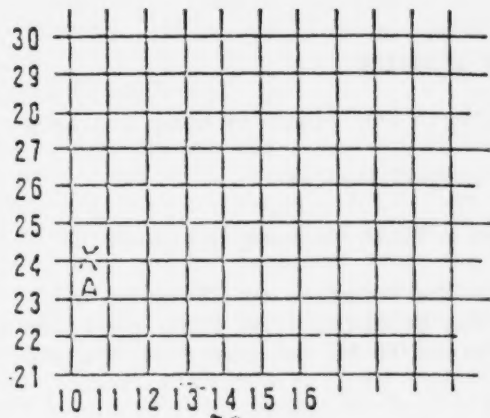
Step 1: Plot observer A's location at coordinates 105240.

Step 2: From observer A's location draw a line on an azimuth of 35° Grid.

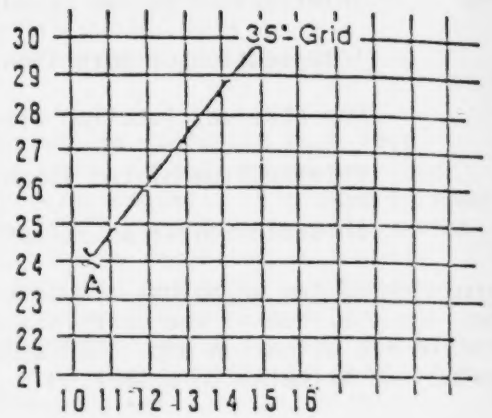
Step 3: Plot observer B's location at coordinates 157220.

Step 4: From observer B's location draw a line on an azimuth of 340° Grid. Where the lines intersect at coordinates 133280 is determined to be ground zero.

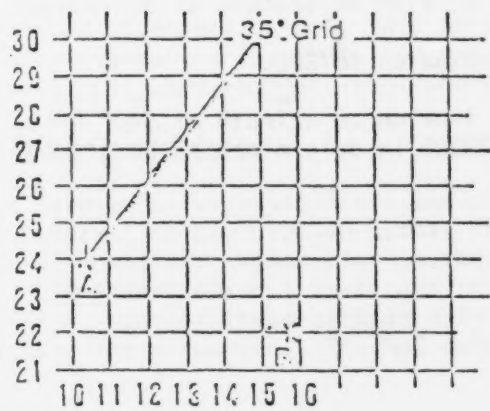
INTERSECTION OF TWO AZIMUTHS.



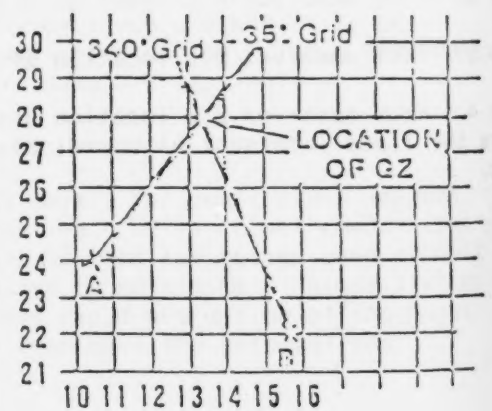
STEP 1



STEP 2



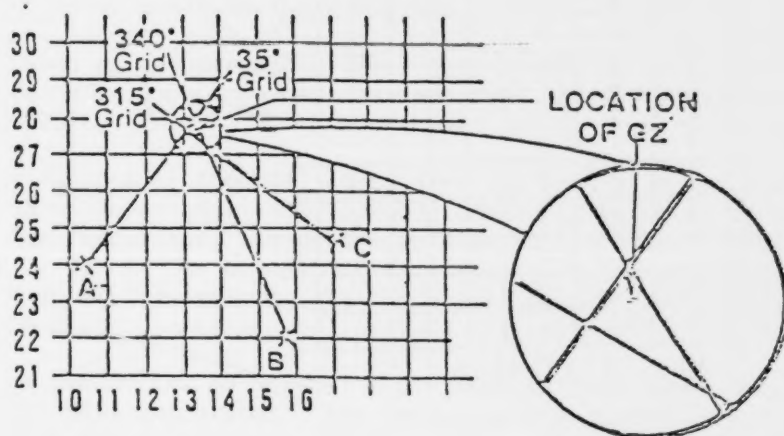
STEP 3



STEP 4

Intersection of more than two azimuths. When available, more than two azimuths can be used to more accurately locate GZ. This is accomplished by plotting the observer's locations and reported azimuth on the situation map. GZ is then located in the center of the triangle formed by the intersecting azimuths.

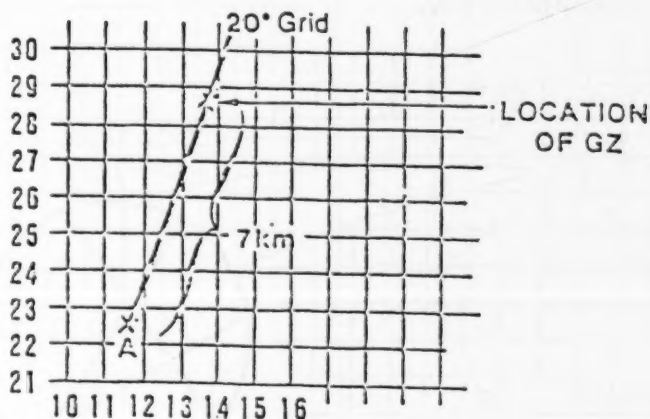
INTERSECTION OF MORE THAN TWO AZIMUTHS.



One observer reporting azimuth and flash-to-bang time (Polar Plot). To determine the location of GZ when only one designated observer has reported an azimuth and flash-to-bang time, plot the observer's location and reported azimuth. The flash-to-bang time must then be converted to a distance to GZ using the appropriate nomogram. Using the yield estimation nomogram, locate the reported flash-to-bang time on the center scale. Reading on the other side of the same scale, determine the distance to GZ. This procedure is used in the company, battalion, and brigade headquarters to plot ground zero. EXAMPLE: Flash-to-bang time is 20 seconds, distance to ground zero is 7 km. The distance to GZ can also be determined by multiplying the flash-to-bang time by 0.35. EXAMPLE: $20 \times .35 = 7 \text{ km}$.

After determining the distance to GZ measure that distance on the Graphic Scale (1000 meters per kilometer) and transfer it to the azimuth line, measuring from the observer's location.

ONE OBSERVER AZIMUTH AND FLASH-TO-BANG TIME.



EXAMPLE: Observer A (coordinates 115225) reported a measured azimuth of a nuclear cloud as 20° Grid. The same observer reported a flash-to-bang time of 20 seconds. After plotting the observer's location and azimuth, the distance to GZ was determined to be 7 km. When plotted on a map, GZ is determined to be at 138289.

Two or more observers reporting flash-to-bang time. To determine the location of GZ when two or more observers report their location and both report a flash-to-bang time but no azimuth, plot the observers' locations on the map. You then determine the distance to GZ based on the flash-to-bang time using the nomogram or the mathematical method. Using a drawing compass or a piece of string, measure the distance to GZ on the Graphic Scale of the map. From each observer location draw an arc at the computed distances. GZ is considered to be at the point where the arcs intersect.

YIELD ESTIMATION

Commanders at unit level need only an approximate yield value. This yield value is used to enter the broad yield groups of the effective downwind message. The data for the appropriate yield group of this message are used to make simplified fallout predictions.

Unit level work conditions are so varied that use of nomograms may be impossible. While the NBC defense team can carry or maintain field manuals or field circulars for a limited period of time, the team may not be able to do so over an extended period of time. The M4A1 yield calculator can also be used by the NBC defense team to determine yield. With practice, the calculator is as accurate as the nomograms used by the NBCC but more durable and convenient to use. The M4A1 calculator is designed to provide rapid yield estimation based on any parameter other than cloud-top or cloud-bottom height. This calculator is a part of the M28A1 RADIAC Calculator Set, NSN 6665-00-130-3616.

Instructions for use of the M4A1 calculator are on the instruction card in the set. This card has an additional purpose of providing check problems. Upon receipt of the calculator, the user should solve the sample problems on the instruction card. If the calculator will not solve the sample problems to within the specified tolerance, the calculator must be destroyed and a new one obtained. Complete operating instructions are contained in TM 3-6665-303-10.

There are two situations of which the unit NBC defense teams should be aware when using the M4A1 calculator. The calculator is essentially a round nomogram with a fixed hairline. At times, the yield pointer may go off-scale on either the high or low end of the yield scale. Seemingly erroneous answers could be read. Familiarity with the calculator and an appreciation for the size of a nuclear cloud in relation to the observer-GZ distance (flash-to-bang time) will eliminate these operator problems. Such problems should only occur in training situations. In the field an off-scale large or small yield should be apparent from the data and visual observation of the cloud.

For example, assume a nuclear cloud is 20 mils wide. Flash-to-bang time was 10 seconds. In effect, this is a small cloud very close to the observer indicating a small yield. While the calculator apparently shows a yield of 1000 KT, the actual yield is off the low end of the scale and less than 0.02 KT. In actuality, the reporting observer could not have survived a 1 MT yield to make the calculation. Conversely, a nuclear cloud to angle of 80 degrees with a flash-to-bang time of 120 seconds is a large cloud very far away. This time the calculator could be read as a yield of less than 0.01 KT (which probably could not have been observed) but the actual yield is greater than 10,000 MT (off the high end of the scale).

The M4A1 calculator provides a rapid yield estimation method. The durability, size, ease of operation of the calculator make it a suitable method of rapid yield estimation.

The GZ location and estimated yield calculated at unit level are used to create a simplified fallout prediction. Upon receipt of the NBC 2 report from the NBCC the original simplified fallout prediction is revised using the new data. When the NBC 3 report is received, all simplified fallout predictions are superseded. This approach allows the unit commander to make estimates and decisions based on the best available information at the time.

In this lesson, however, you will learn to use a nomogram to calculate weapons yield. Training to use nomograms for weapon yields will be more apparent later when you learn to use other nomograms to make additional calculations for operating in a radiologically contaminated area.

CALCULATE NUCLEAR WEAPONS YIELD

Estimation of the yield of a nuclear weapon can be a critical factor in the decisions made by a commander. The estimated yield is based upon nuclear burst data submitted by reporting units. The accuracy of nuclear burst data will dictate the reliability of the yield estimate. Reporting units may provide different elements of the nuclear burst data. Therefore, several methods of yield estimation have been developed. Yield estimation is based on development of nuclear clouds. For yield estimation purposes, nuclear cloud development has three stages. The fireball stage begins at the instant of detonation. It will continue until the cloud of explosion products ceases to radiate a brilliant light. As this brilliant light fades into dull glow, the cloud (low air/surface burst). Severe turbulence and rapid growth in height and width are characteristics of this stage of development. This stage lasts until the cloud stabilizes in height (4 to 14 minutes after detonation). When taking cloud measurements, it is accomplished at $H + 5$ minutes or $H + 10$ minutes, with H as time of detonation. When the cloud ceases to grow in height, the stabilized cloud stage begins. This stage continues as long as the cloud is detectable. Nuclear burst cloud measurements or parameters have been correlated with yield and are presented in nomograms, each of which is an independent means of determining an estimated yield.

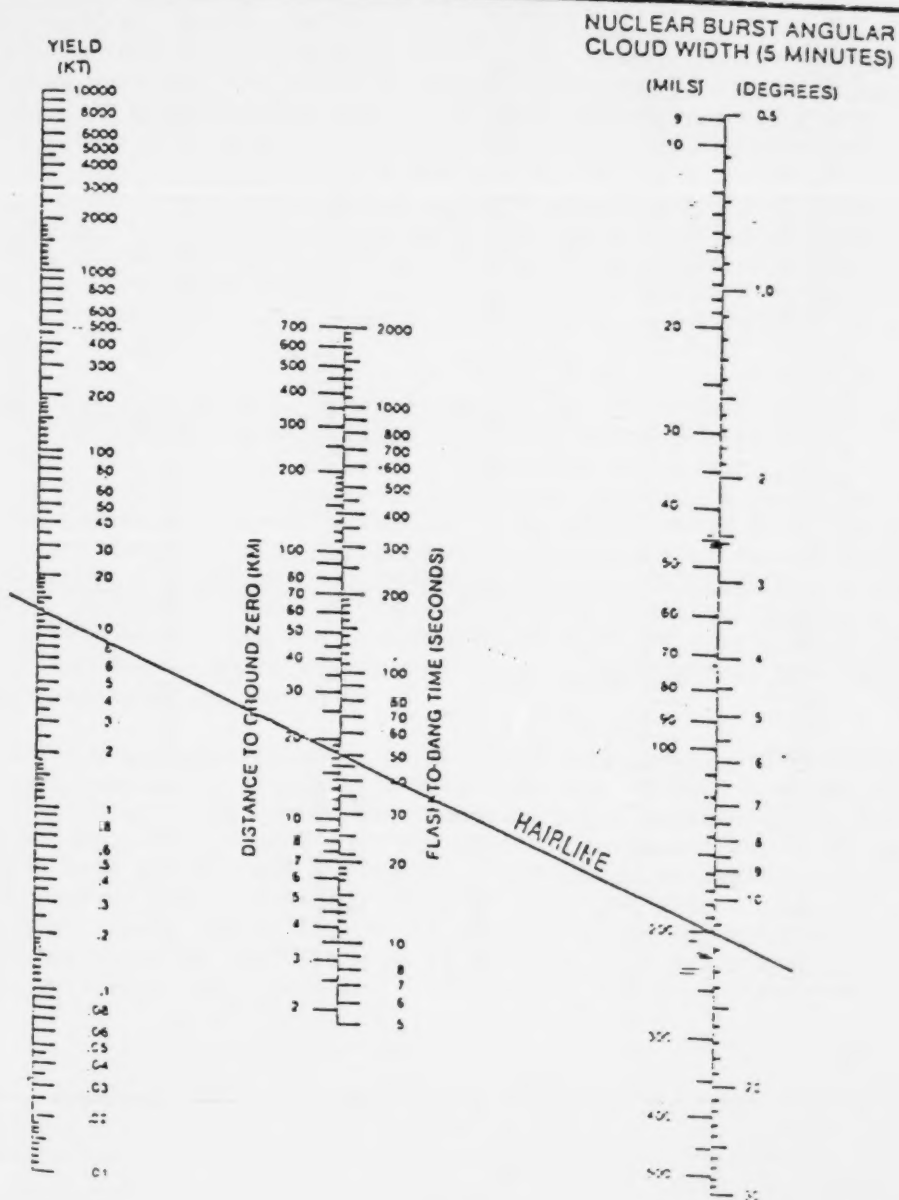
Nuclear Cloud Parameters (Listed in Order of Decreasing Reliability)

If any of the following combinations of nuclear burst parameters are known an estimated yield can be determined from nomograms.

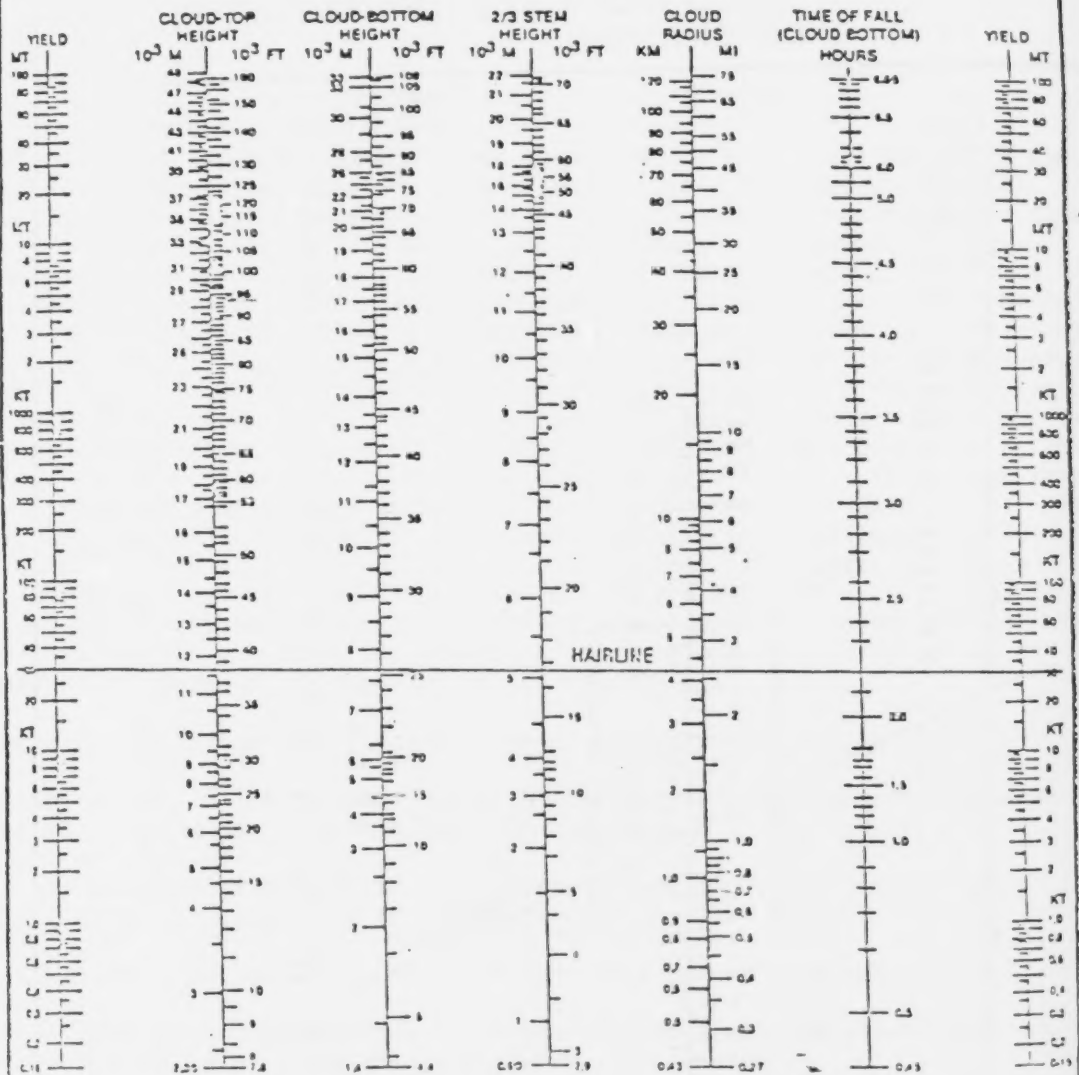
- Distance to ground zero (or flash-to-bang time) and nuclear burst angular cloud width ($H + 5$ minutes)
- Stabilized cloud-top or cloud-bottom height ($H + 10$ minutes)
- Distance to ground zero (or flash-to-bang time) and stabilized cloud-top or cloud-bottom angle ($H + 10$ minutes)-

Nuclear Burst Angular Cloud Width. The Nuclear Burst Angular Cloud Width nomogram is used to determine yield from nuclear burst angular cloud width measurement and distance to ground zero (or flash-to-bang time). The right hand scale is the nuclear burst angular cloud width in mils or degrees, the center scale is the flash-to-bang time in seconds and the distance in kilometers to ground zero, and the left hand scale is the yield in kilotons (KT).

YIELD ESTIMATION (FLASH-TO-BANG TIME OR DISTANCE TO GROUND ZERO VERSUS NUCLEAR BURST ANGULAR CLOUD WIDTH AT 5 MINUTES AFTER DETONATION).



RADIOACTIVE CLOUD AND STEM PARAMETERS (STABILIZED AT H + 10 MINUTES).



Place a hairline from the point of the right hand scale, representing the nuclear burst angular cloud width at 5 minutes after detonation, through the point on the center scale representing flash-to-bang time and distance to ground zero. At the point of intersection of the hairline and the left hand scale, read the yield.

For example the data determined by an observer indicated a flash-to-bang time of 50 seconds and a nuclear burst angular cloud width of 200 mils. To estimate the corresponding yield by using the nomogram, connect 200 mils on the right hand scale and 50 seconds on the center scale with a hairline; at the point of intersection of the hairline and the left hand scale, read a yield of about 13 KT.

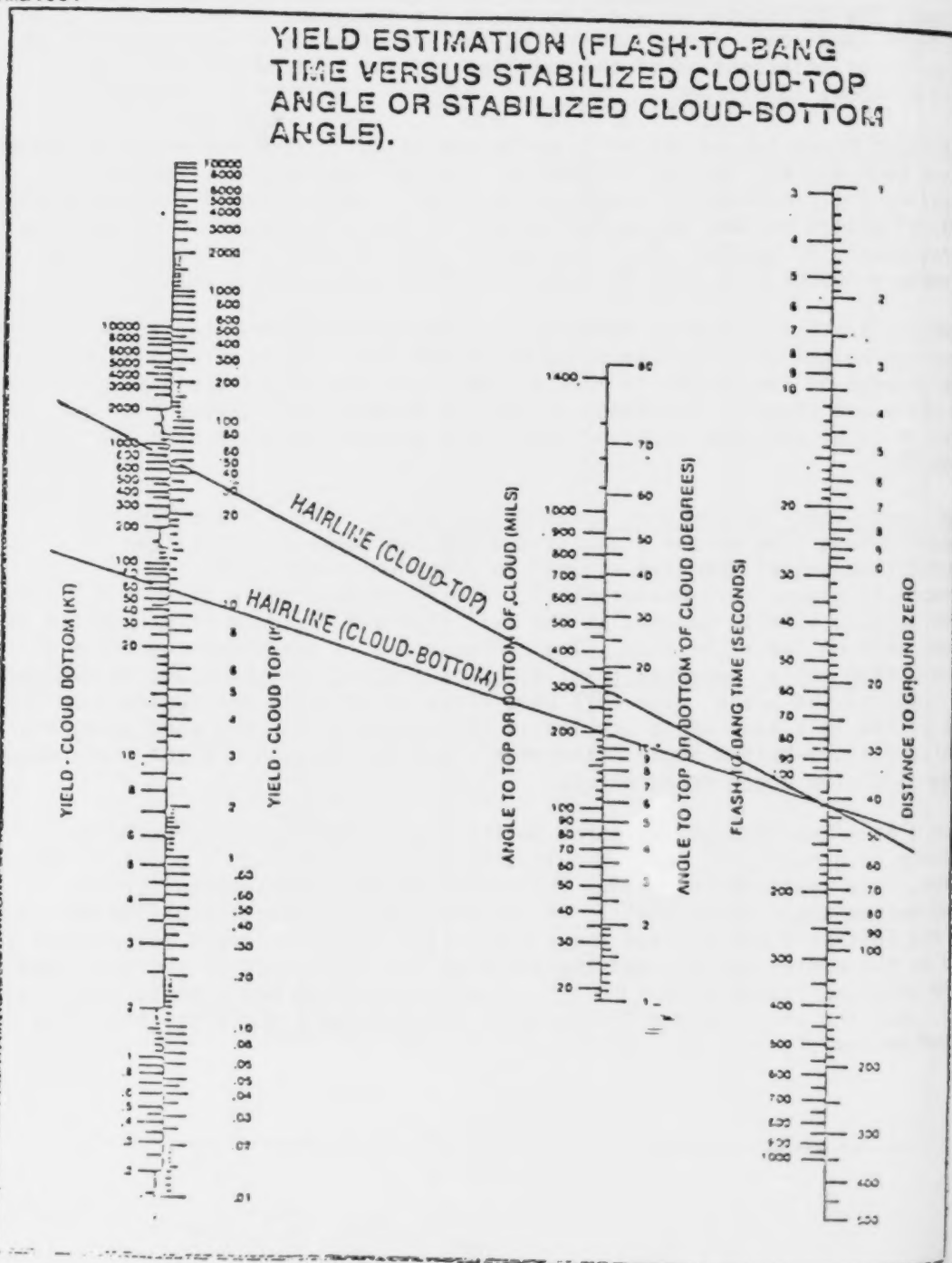
Stabilized Cloud-Top Height or Cloud-Bottom Height. If cloud width or angles cannot be measured, the use of tactical aircraft may be justified for measuring the cloud-top or cloud-bottom height. Measurements (in thousands (103) of meters or feet above the surface of the ground) should be made at approximately 10 minutes after the burst. The radioactive cloud and stem parameters nomogram is used to correlate these measurements with yield.

EXAMPLE: A pilot flying an observation plane measures the stabilized cloud-top height of a nuclear cloud as 38,000 feet. By placing a hairline or straightedge on the 38,000 ft mark of the cloud-top height scale (figures on the scale are shown in thousands of feet or meters) and turning the hairline until it is at the same point on both yield scales, you determine the yield to be 30 KT.

Stabilized Cloud-Top Angle or Cloud-Bottom Angle. The yield estimation (flash-to-bang time versus stabilized cloud-top angle or stabilized cloud-bottom angle) nomogram is used to determine yield from distance-to-ground zero measurements. The right hand scale gives the flash-to-bang time in seconds on the left side and distance in kilometers to ground zero on the right side. The center scale is the cloud-top angle or cloud-bottom angle, measured in mils on the left of the scale and in degrees on the right of the scale. The left hand scale is actually two scales. On the left of the left hand scale are listed the yields to be read when using the stabilized cloud-bottom angle measurements and on the right is the yield when using cloud-top angle measurements.

Place a hairline through the point on the right hand scale representing distance-to-ground zero, or flash-to-bang time, and through a point in the center scale representing either the cloud-top angle measurement or the cloud-bottom angle measurement. At the point of intersection of the hairline and the left hand scale, read the yield. If a cloud-top angle measurement is used on the center scale, read the yield on the right side of the left hand scale entitled "Yield (Cloud Top)." If a cloud-bottom angle measurement is used, read the yield on the left side of the left hand scale entitled "Yield (Cloud Bottom)."

For example, an observer reports a flash-to-bang time of 120 seconds, angle to cloud top of 300 mils. Place a hairline from 120 seconds on the flash-to-bang time scale through 300 mils on the left side of the angle scale; the yield is read as 50 KT on the right side (cloud top) of the yield scale. The observer may have reported a cloud-bottom angle of 200 mils. In this case, place the hairline from 120 seconds on the flash-to-bang time scale through 200 mils on the left side of the angle of the yield scale; the yield is read at 60 KT. It is emphasized that these yield calculations are field estimates.



Resolved Yield

All of the yield estimation techniques result in approximate yields. Occasions will arise when the data from several observers concerning a single attack will not result in the same yield. In this case, the arithmetic average of the yields is used, which also, is an estimated yield.

The actual yield to be reported to the field units is termed the resolved yield. To determine the resolved yield, the NBCC maintains a summary of enemy nuclear capabilities. This summary may reflect order of battle, delivery units, and known yields. These data are determined from G2 and other intelligence sources.

In using the summary, the NBCC compares the estimated yield (or average estimated yield) with known enemy yields. This estimated yield will indicate which known enemy yield actually detonated. Ideally, only this resolved yield is reported to field units in the NBC 2 report. The resolved yield is also the basis for detailed fallout prediction (NBC 3 report).

The NBC 2 Report

The NBC 2 report contains the evaluated nuclear burst data. The report is created only by the NBCC and presents the detailed evaluation of all raw data. These raw data are automatically submitted by designated observer units each time the enemy attacks with nuclear weapons.

Precedence of the NBC 2 report is established by the NBCC. Since precedence is based on urgency, an NBC 2 report may have one precedence when the recipient is in a danger zone and another when a unit is not in an affected area.

NBC 2 report are created for all burst -- air, surface, and unknown. When type of burst is reported as surface or unknown, fallout predictions are made.

The format for the NBC 2 report is shown below. Line items may be repeated as many times as necessary to summarize all attack data into a single report. Users are not restricted to the line items shown. Other line items may be added as appropriate.

PRECEDENCE (Determined by NBCC)

DATE/TIME OF MESSAGE

CLASSIFICATION (Normally unclassified)

FROM (Class sign or destination of headquarters of NBCC)

TO (Determined by NBCC based on immediate operational needs)

NBC 2 NUCLEAR REPORT

ALFA	Strike Serial Number
DELTA	Date/Time of the Attack (ZULU or local)
FOXTROT	Location of attack -- UTM or place (actual or estimated, state which)
HOTEL	Type of Burst -- air, surface, or unknown (state which). Include height of burst, if known.
NOVEMBER	Estimated Yield (KT)

The NBCC establishes the communication means for the NBC 2 report. The report is sent to all affected subordinate units immediately. Unaffected units receive the report later. Each NBC 2 report must also be sent to higher headquarters NBCC and adjacent headquarters NBCC. This allows planning for future missions or boundary changes.

Additional data may be received after the NBC 2 report is sent. If this data changes the yield of GZ location, a new NBC 2 report is sent. The same strike serial number and date/time of attack are used.

To understand the NBC 2 (Nuclear) Report, you must know what is contained in each line of the report format.

Precedence. The NBC 2 (Nuclear) Report is normally transmitted using an IMMEDIATE precedence.

Date/time (Local and ZULU). The date and time the report is sent, local or ZULU time must be designated. NATO forces operating in a NATO area should use only ZULU time on these reports. For instance, 1:30 pm ZULU time on the 18th of the month would be shown as 181330Z. The month and year are not shown.

Security Classification. Normally the security classification will be UNCLASSIFIED.

From. This line identifies what unit is sending the message.

To. This line identifies the agencies to which the report is being sent.

Type of Report. This line identifies the report as an NBC 2 (Nuclear) Report.

<u>LINE ITEM</u>	<u>MEANING</u>
ALFA	This line contains the strike serial number assigned to the attack. All future NBC (Nuclear) reports pertaining to that attack will show the same strike serial number.

DELTA Date and time of detonation shown in local or ZULU time. Local or ZULU must be shown.

FOXTROT Location of the attack can be shown either as a place or by grid coordinates. It can be shown as actual or estimated. This must be specified. (EXAMPLE: NY492837 Estimated). This location is calculated from observer information on the NBC-1 (Nuclear) Reports.

GOLF Means of delivery, if known, should be shown in this line.

HOTEL Type of burst - air, surface, or unknown - is shown on this line.

NOVEMBER After calculating the estimated yield from the observer data, it is entered on this line.

DEFECTIVE DOWNWIND MESSAGE

Use of a simplified fallout predictor requires knowledge of the effective wind speed and downwind direction. This information is prepared by the NBCC as an Effective Downwind Message and is transmitted to subordinate and adjacent units each time new upper air wind data are received. The latest Effective Downwind Message should always be used. Effective Downwind Messages more than 2 hours old should not be used for fallout prediction.

The Effective Downwind Message consists of line ZULU, which represents the date and time which the winds were measured, and lines ALFA through GOLF. Lines ALFA through GOLF normally contain six digits, the first three digits representing the direction the wind is blowing toward in degrees, and the last three digits represent the wind speed in kilometers per hour.

Effective Downwind Message

ZULU	301200Z
ALFA	318027
BRAVO	302027
CHARLIE	289025
DELTA	284025
ECHO	276025
FOXTROT	269027
GOLF	263029

The wind information in lines ALFA through GOLF is to be used for nuclear calculations for bursts within a yield group. The example below shows the yield groups as they pertain to each line of the Effective Downwind Message.

Nuclear yield groups

ALFA	0-2 KT
BRAVO	over 2 KT thru 5 KT
CHARLIE	over 5 KT thru 30 KT
DELTA	over 30 KT thru 100 KT
ECHO	over 100 KT thru 300 KT
FOXTROT	over 300 KT thru 1000 KT
GOLF	over 1 MT thru 3 MT

Therefore, if there was a nuclear detonation with a 4 KT yield, the wind information in line BRAVO would be used to make the fallout prediction. This limitation would preclude a precise simplified fallout prediction using wind information calculated specifically for a 4 KT yield. The NBC 3 (Nuclear) Report prepared by the NBCC would, however, be based on calculations for a 4 KT yield.

Under certain weather conditions, an Effective Downwind Message may be prepared that will show only three digits in one or more lines, or a number in parentheses following the six digits in a line. (Example below.)

Effective Downwind Message showing special cases.

ZULU	301200Z
ALFA	004
BRAVO	006
CHARLIE	273038
DELTA	269036 (60)
ECHO	255037
FOXTROT	263037
GOLF	263029

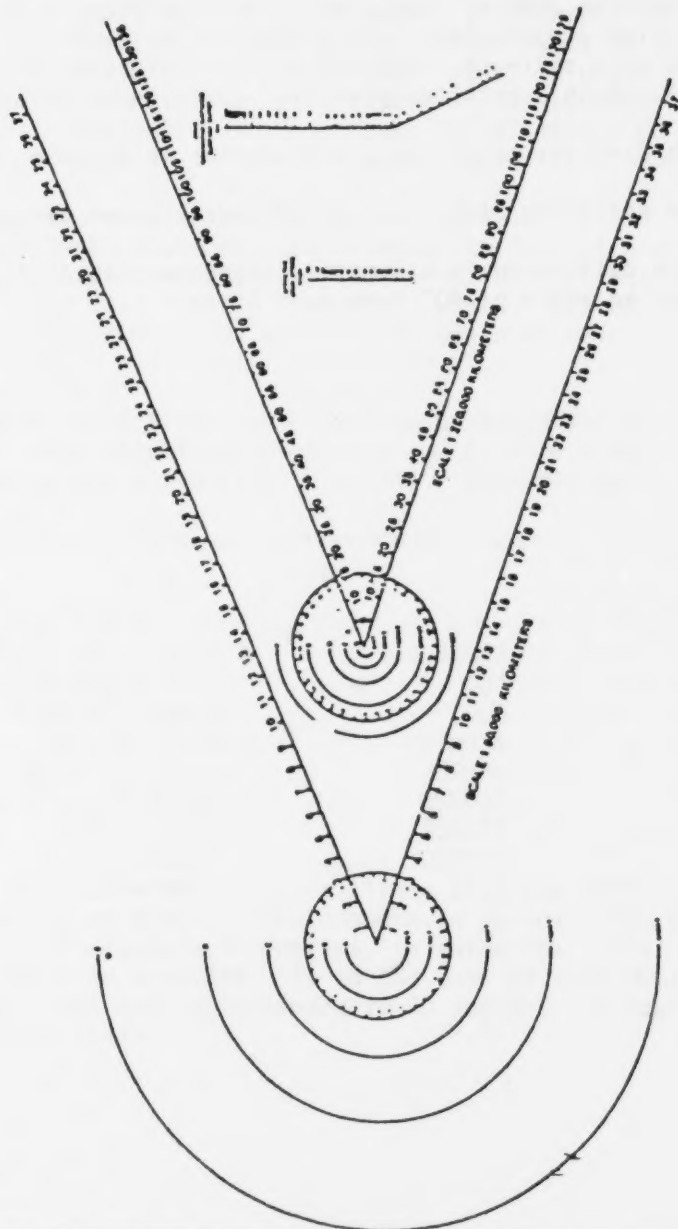
In these special cases, the three digits (lines ALFA and BRAVO), represent the downwind wind distance to ZONE I. The numbers in parentheses represent an angle greater than the standard 40 degrees, to which the radial lines of the fallout predictor must be expanded. As in the case of line DELTA, the angle between the radial lines must be expanded to 60 degrees (30 degrees on each side of the reference line).

AREA PREDICTOR, RADIOLOGICAL FALLOUT M5A2

The Area Predictor, Radiological Fallout M5A2, is a transparent device. It is used to outline the zones of hazard resulting from surface or near surface nuclear bursts for preselected yield groups. The M5A2 fallout predictor is composed of two simplified predictors. It also has a nomogram for determining the downwind distance to ZONE 1. One simplified predictor is drawn to a scale of 1:50,000, with five preselected yield groups (A, B, C, D, E). The other predictor is drawn to a scale of 1:250,000 with six preselected yield groups (A, B, C, D, E, F). Each simplified predictor consists of three major parts.

1. An azimuth dial for orienting the predictor to the map.
2. Semicircle depicting stabilized cloud radius drawn around ground zero.
3. A map scale calibrated in kilometers along two radial lines extending from ground zero at an angle of 40° from each other.

AREA PREDICTOR, RADIOLOGICAL FALLOUT M5A2.



PREPARE SIMPLIFIED FALLOUT PREDICTION

The simplified fallout prediction method is designed for use by small unit commanders. It is used to make an immediate estimate of the location of the potential fallout hazard. It is used while waiting for a detailed fallout prediction message, NBC 3 (Nuclear) Report. The simplified prediction method requires nuclear burst information, a current effective downwind message, and a simplified fallout predictor.

To draw a fallout prediction, you must do the following:

- Gather required information.
- Identify the prediction.
- Determine wind direction and speed.
- Determine downwind distance of ZONE I and ZONE II.
- Draw tangent lines.
- Draw time-of-arrival arcs.
- Orient the predictor.

Gather Required Information. Normally, the nuclear burst information giving the date/time of the burst, location of ground zero, and estimated yield will be taken from the NBC 2 (Nuclear) Report.

Identify the Prediction. The prediction is identified by recording as a minimum the location of ground zero and the date/time of burst on the predictor.

Determine Wind Direction and Speed. The effective downwind direction and speed are taken from the appropriate yield group line of the effective downwind message. The wind direction is used to orient the predictor to the map. The wind speed is used to determine the downwind distance of ZONE I and the time of arrival arcs.

Determine Downwind Distance of ZONE I and ZONE II. The downwind distance of ZONE I is determined from the nomogram on the M5A2 fallout predictor. This determination is made by placing a hairline or straightedge on the point of the left scale representing the wind speed and the point on the right scale representing the estimated or actual yield of the weapon (not the yield group). The downwind distance of ZONE I is the point where the hairline or straightedge crosses the center scale. When this point is between two numbers on the scale, you must determine the ZONE I distance as accurately as possible by average/interpolation. As in the example below the yield is 40 KT and the wind speed is 35 kmph. The hairline crosses the center scale at the 40 km point, therefore the ZONE I downwind distance is determined to be 40 m. The downwind distance of ZONE II is twice that of ZONE I. Arcs are drawn

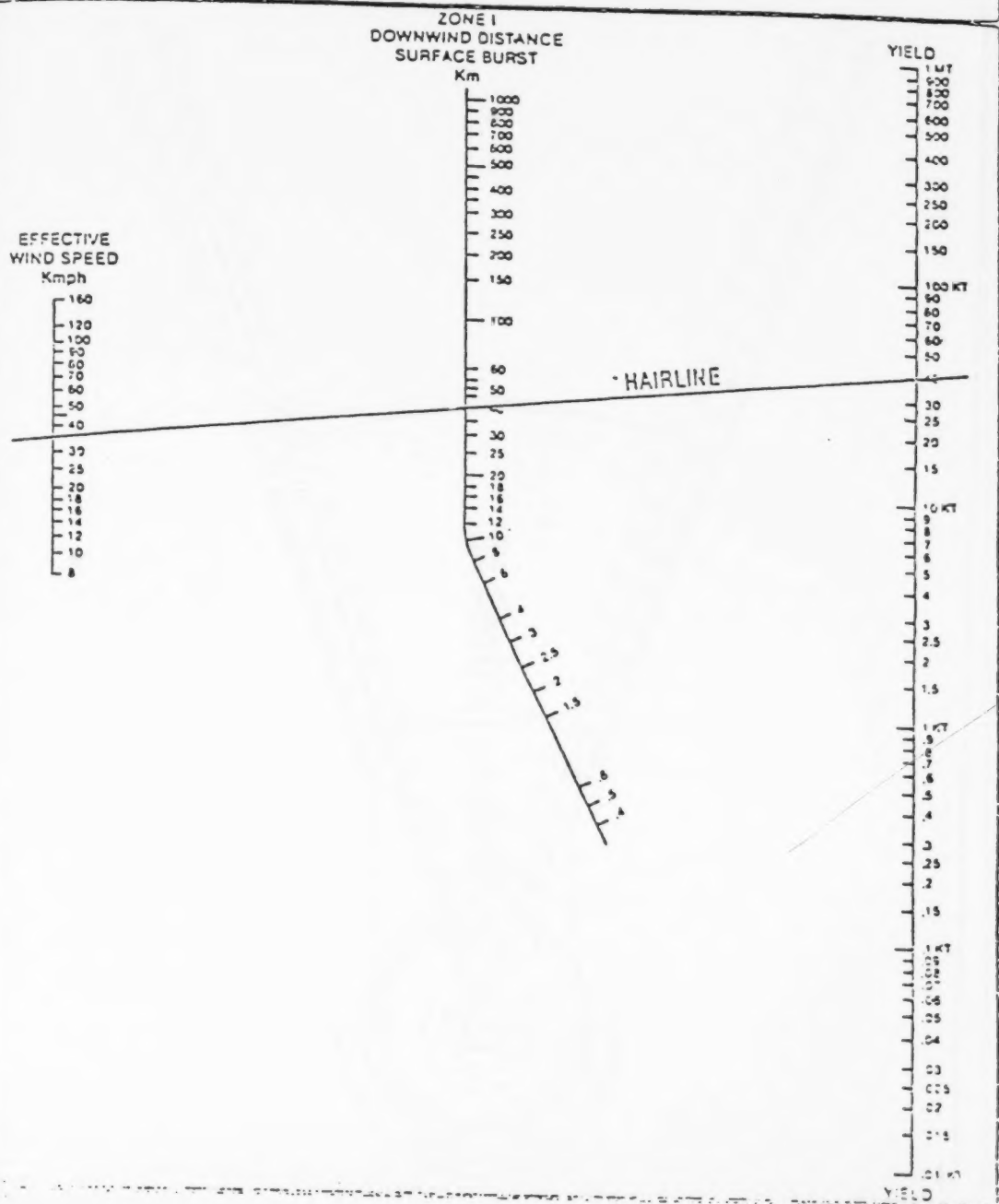
between the two radial lines at the respective downwind distances using ground zero as the center point. Label ZONE I and ZONE II.

Draw Tangent Lines. Tangents are drawn from the cloud radius semicircle for the yield group selected, to the point where the radial lines intersect with the arc representing the downwind distance to ZONE I.

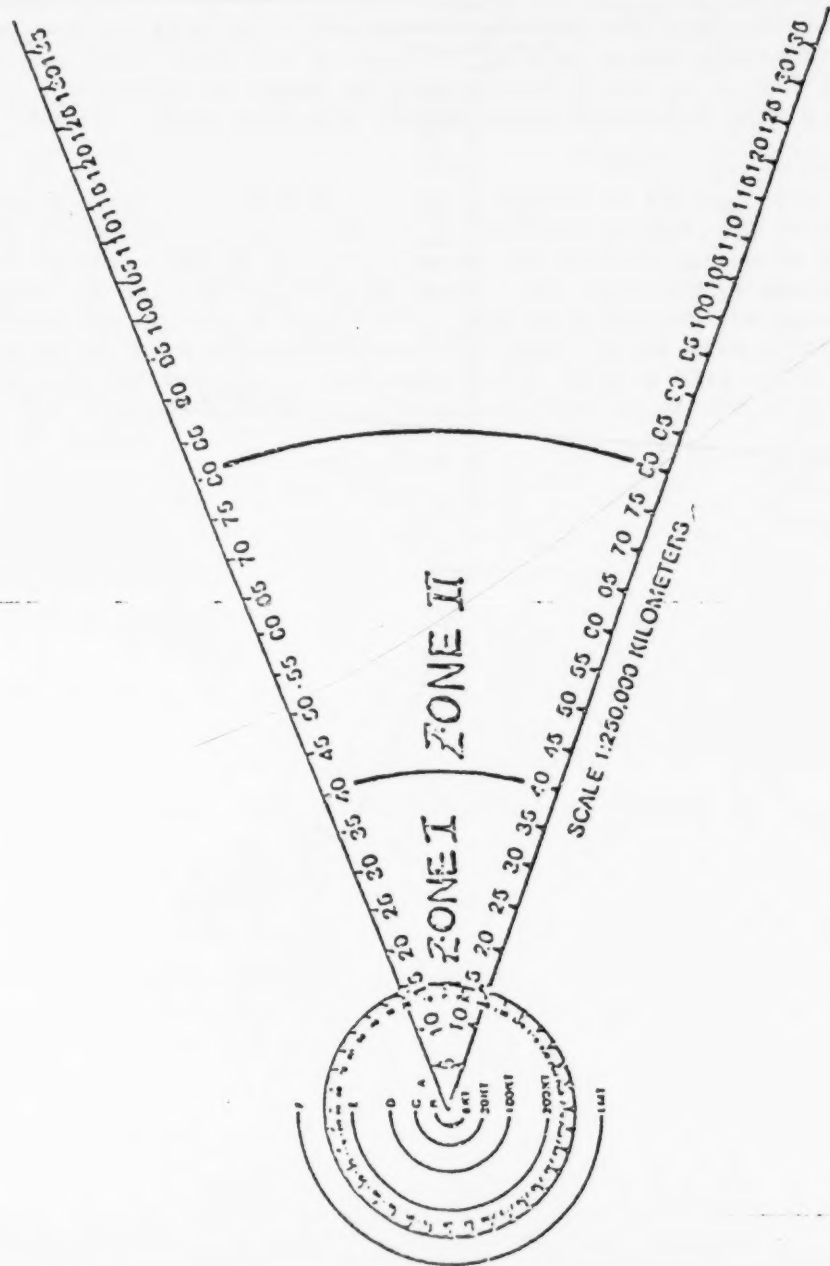
Draw Time-of-Arrival Arcs. Time-of-Arrival arcs are drawn as a dashed line between the radial lines (or tangents if between ground zero and ZONE I arc) using the effective wind speed as the downwind distance for $H + 1$, etc, through ZONE II. These arcs are labeled along the radial line a $H + 1$, $H + 2$, etc.

Orient the Predictor. The predictor is oriented to the map by placing the predictor ground zero over the actual or assumed ground zero on the map. The predictor is then rotated until the effective wind direction in degrees on the azimuth dial is pointed toward grid north. You may find it easier to orient the predictor by drawing a line from ground zero through the point of the azimuth dial at the wind direction. Label the line as grid north (GN). The map and prediction must be of the same scale; in this case 1:250,000. Identify the prediction by adding the coordinates of ground zero and the date and time of burst.

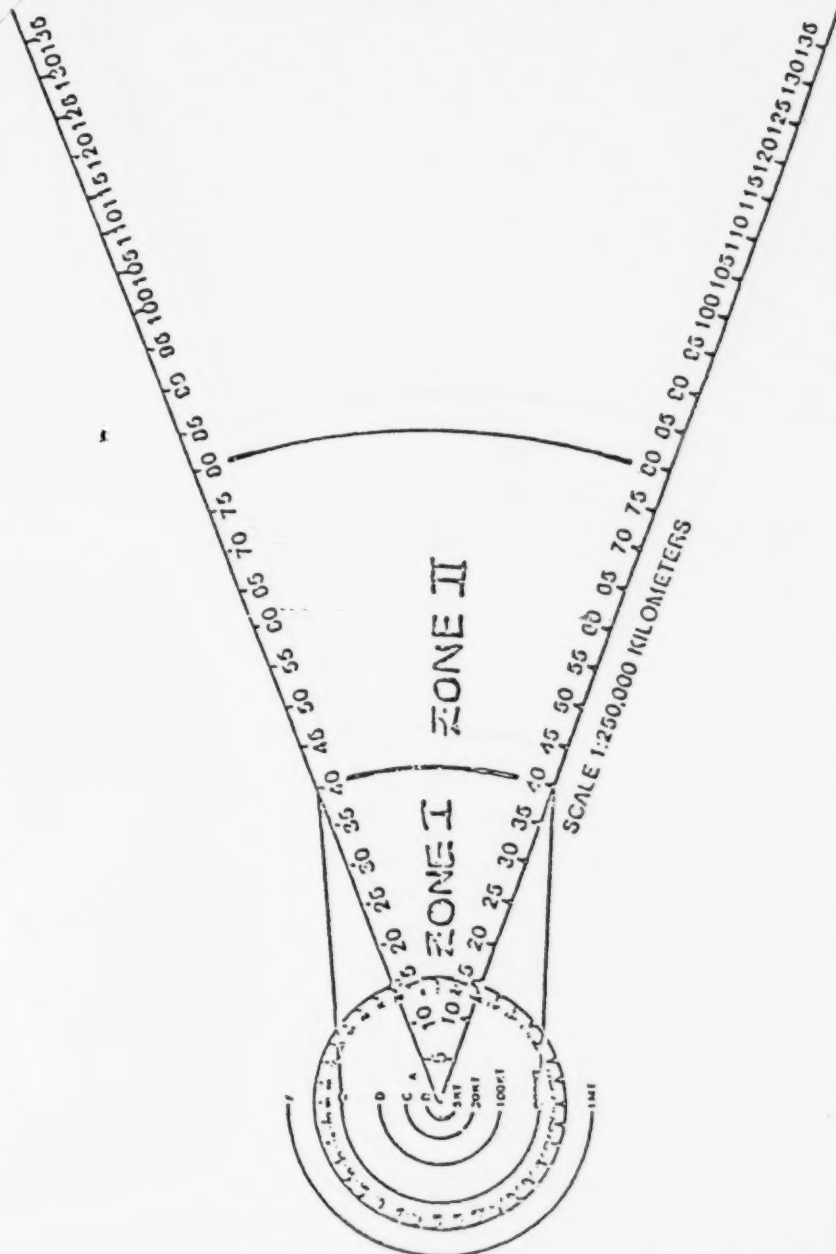
ZONE I DOWNWIND DISTANCE NOMOGRAM ON THE M5A2 FALLOUT PREDICTION.



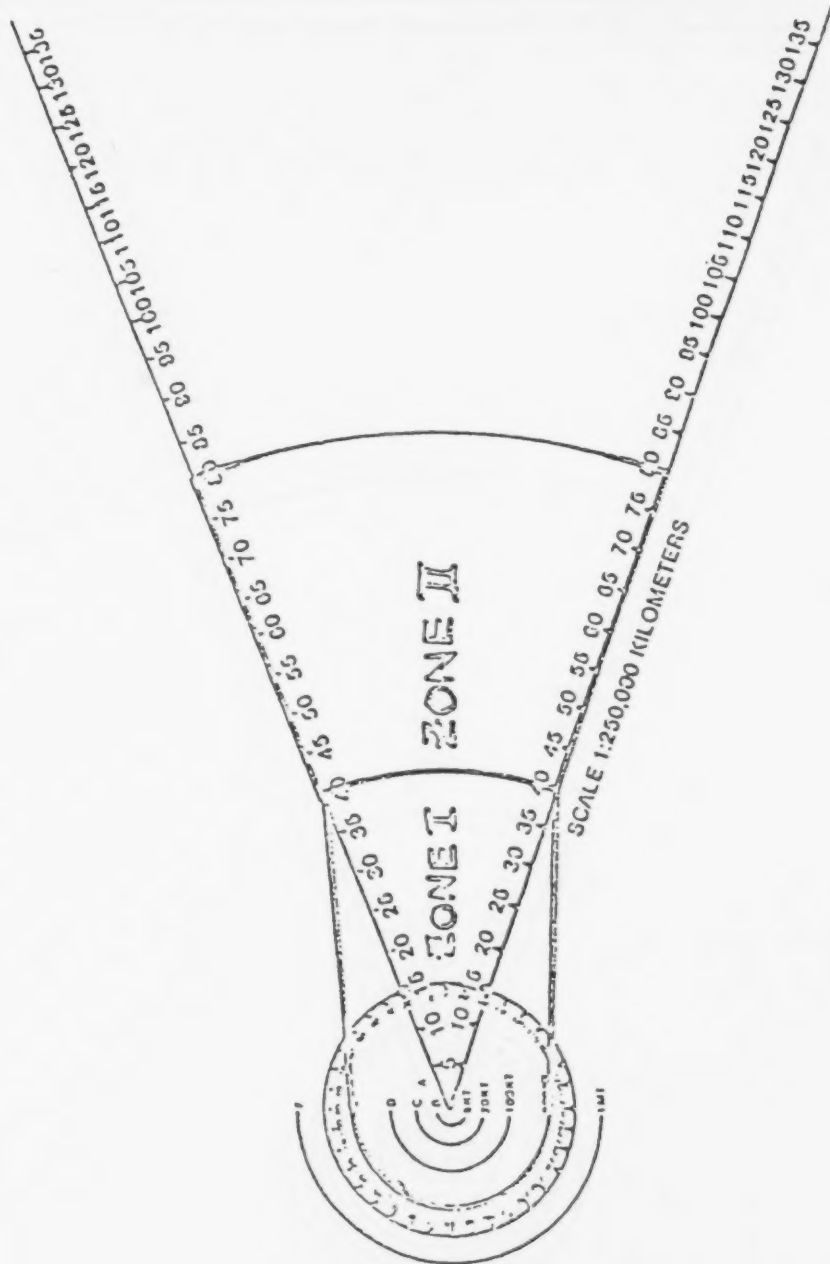
ZONE I AND ZONE II.



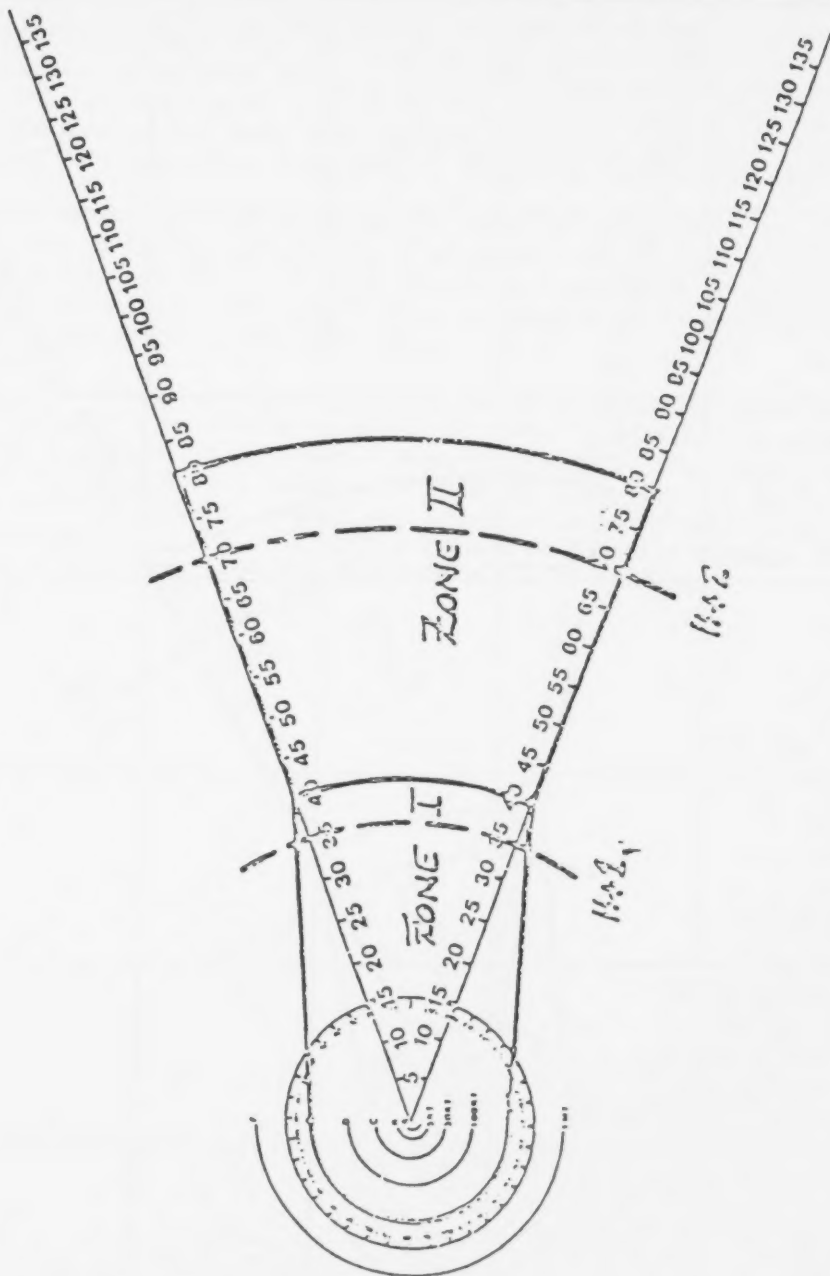
TANGENT LINES.



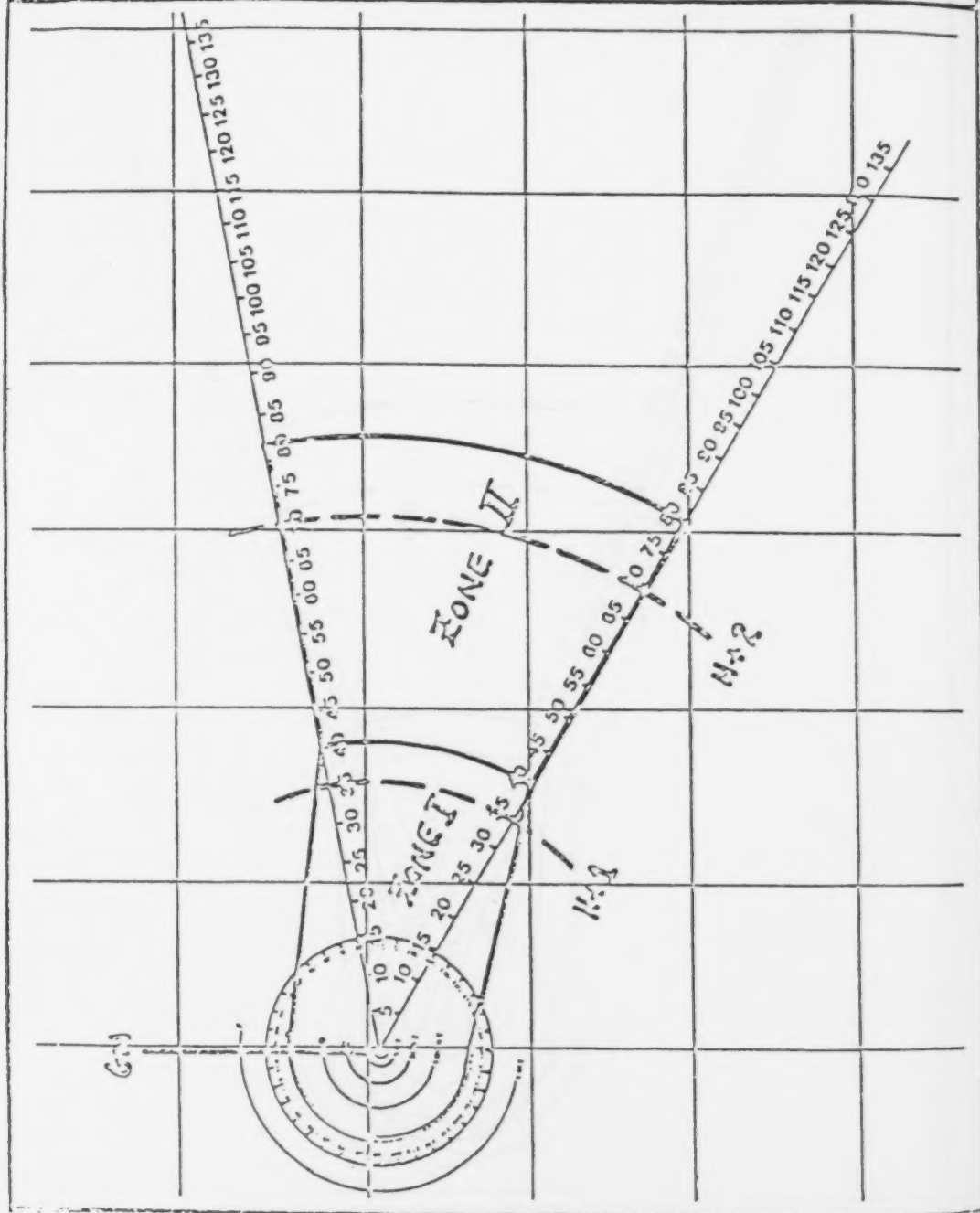
TRACE PERIMETER.



TIME OF ARRIVAL ARCS.



ORIENTATION LINE.

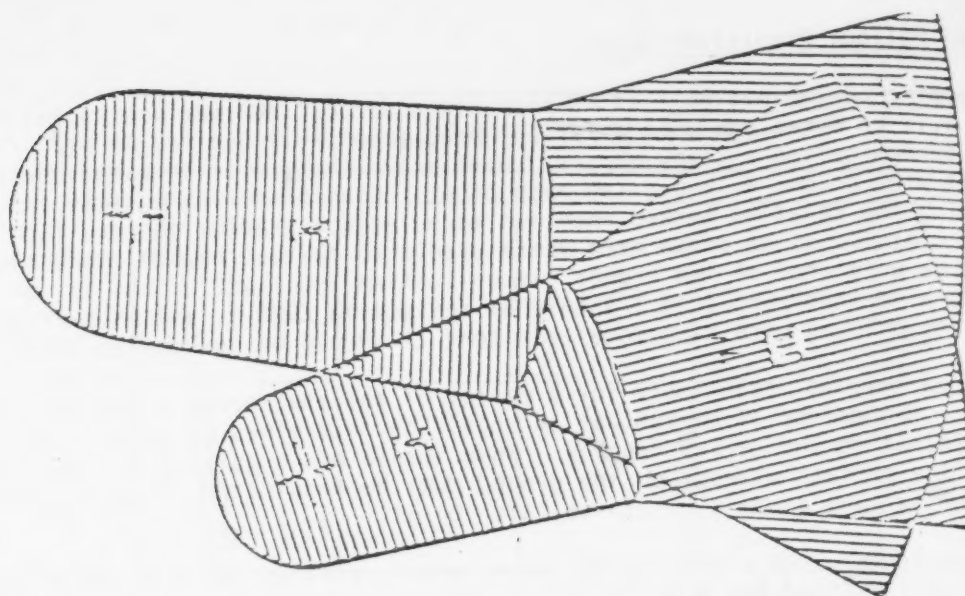


Special Fallout Prediction Cases

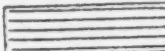
Overlapping contamination. It is probable under nuclear warfare conditions there will be occasions when a fallout prediction will overlap an area in which contamination already exists. Similarly, there will be cases when fallout predictions will overlap each other. Use the following rule for determining the relative hazard when two more fallout predictions overlap: "the hazard classification of an area where predicted fallout hazard zones overlap should be only that of the higher classification involved." That is, an overlap area involving Zone I should be designated ZONE I, and an overlap area involving nothing more hazardous than Zone II should be designated ZONE II.

The above rule is useful only for a matter of several hours after the bursts. The extent of contamination should be determined as soon as possible from monitoring and survey reports. When bursts are separated by several hours, the pattern already on the ground must be considered in conjunction with the fallout prediction of the later burst.

Very low winds. The situation may arise when the effective wind speed cannot be reliably defined for a particular yield; i.e., when the effective wind speed drops below 8 kilometers per hour. When this occurs, the winds are either light and variable or are constantly changing direction, or both. In such cases, fallout may occur at almost any location around ground zero. Only three digits will appear on the line of the effective downwind message for that yield group. See lines ALFA AND BRAVO in the next example.



ZONE I 

ZONE II 

OVERLAPPING FALLOUT PREDICTIONS

EFFECTIVE DOWNWIND MESSAGE.

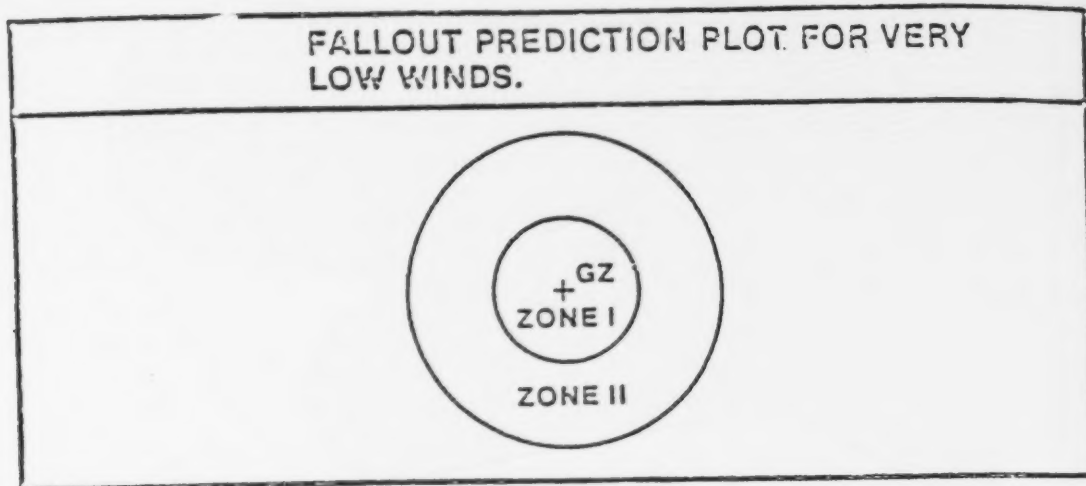
EFFECTIVE DOWNWIND MESSAGE

ZULU	301200Z
ALFA	004
BRAVO	006
CHARLIE	273038
DELTA	269036 (60)
ECHO	260037
FOXTROT	263037

Effective Downwind Message

ZULU	301200Z
ALFA	004
BRAVO	006
CHARLIE	273038
DELTA	269036 (60)
ECHO	299037
FOXTROT	263037

FALLOUT PREDICTION PLOT FOR VERY LOW WINDS

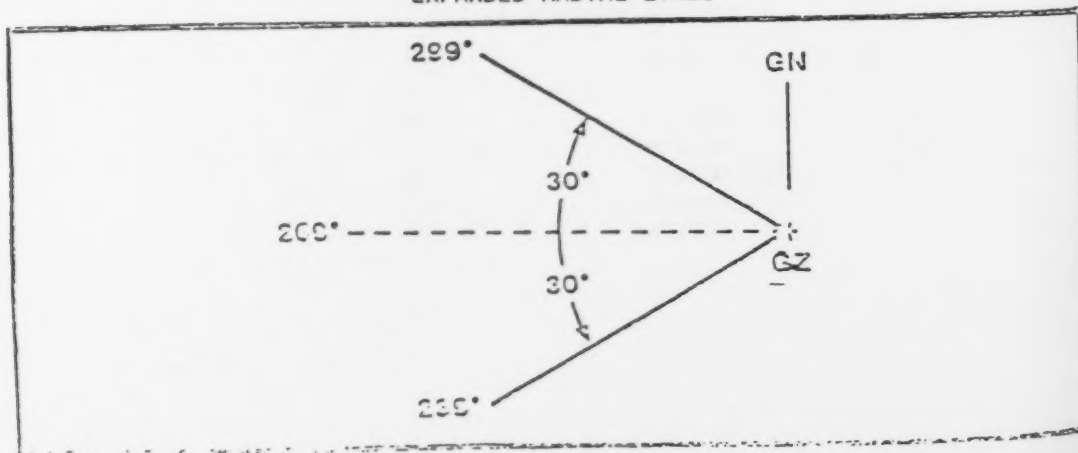


The three digits represent the ZONE I downwind distance in kilometers. A circle of this radius drawn around ground zero will define ZONE I. A second circle of twice this radius will define ZONE II. Time of arrival of fallout will have no meaning in this case and will not be represented on the prediction plot.

Expanded radial lines. There will be instances when the angle between the two radial lines is greater than 40 degrees. In these instances, the effective downwind message will indicate, besides the particular line of the message, the greater angle for the applicable yield group.

In case of line DELTA, the predicted area of fallout will be 30 degrees on each side of the effective downwind direction of 269 degrees.

EXPANDED RADIAL LINES



Times of Arrival.

The downwind distance to which fallout will extend in specified periods of time can be estimated by multiplying the effective wind speed by the time of interest expressed in hours after the burst. Time-of-arrival arcs representing the expected downwind extent of fallout prediction. Time of arrival of fallout at a specific distance from ground zero can be estimated by dividing that distance by the effective wind speed.

$$\text{time of arrival (hr)} = \frac{\text{distance from GZ (km)}}{\text{effective wind speed (kmph)}}$$

For operational purposes, the following rules of thumb may be applied to the actual arrival of fallout:

- The actual arrival of fallout may occur as early as one-half the estimated time of arrival. This is, if the estimated time of arrival of fallout is $H + 4$ hours, actual arrival of fallout may occur as early as $H + 2$ hours.

- If actual arrival of fallout has not occurred at twice the estimated arrival time, or 12 hours, whichever is earlier, then it may be assumed that the area will not receive fallout. That is, if the estimated time of arrival of fallout in an area is $H + 4$ hours and fallout has not occurred as $H + 8$ hours, then it may be assumed that the area will not receive fallout.

PLOT NBC 3 (NUCLEAR) REPORT

CONDITIONS

You are given an NBC 3 (Nuclear) report, an area map, overlay paper or acetate, pencils or grease pencils, a straightedge, a protractor, and GTA 3-6-3.

STANDARDS

1. For an NBC 3 (Nuclear) report with line ZULU (8 digits), the following measures are performed.

- a. Ground zero (GZ) is plotted and labeled on the overlay.
- b. The grid north (GN) line is drawn and labeled on the overlay.
- c. The left and right radial lines are plotted within $\pm$ two degrees.
- d. Zones I and II are plotted within $\pm$ 200 meters and 400 meters, respectively, and labeled.

- e. Time of arrival arcs are drawn within $\pm$ 200 meters and labeled.
 - f. Cloud radius is drawn around GZ within $\pm$ 200 meters tolerance.
 - g. Tangent lines are drawn from the outer edge of the cloud radius to the Zone I arc intersection.
 - h. Marginal information is written on plot and includes map scale, date/time of burst, and GZ grid coordinates.
 - i. The overlay is oriented to the map. GZ is oriented to within 200 meters of actual GZ.
 - j. The completed plot is shown to supervisor.
2. For an NBC 3 (Nuclear) report with line ZULU (3 digits), the following measures are performed.
- a. GZ is plotted and labeled on the overlay.
 - b. Zones I and II are plotted within $\pm$ 200 meters and 400 meters respectively, and labeled.
 - c. Marginal information is written on plot and includes map scale; date/time of burst, and GZ grid coordinates.
 - d. The overlay is oriented to the map. GZ is oriented to within 200 meters of actual GZ.
 - e. The completed plot is shown to supervisor.

REFERENCE

FM 3-3

FALLOUT FUNDAMENTALS

On 22 January 1954, a tuna fishing boat set out from Japan with 23 crew members. By 1 March, it was about 100 miles north-east of Bikini Atoll in the South Pacific. Early on the morning of 1 March, the deck watch saw a great flare of light to the east followed by a huge glowing ball of fire which rose above the horizon. The other crew members came on deck and stared in amazement. Seven or eight minutes later, the boat was rocked by the sound of an explosion. The frightened fishermen began pulling in their nets, but before they could finish, a gray-white ash or dust began settling out of the sky onto the boat. It fell on the deck and the fisherman. The fisherman saw it, but not knowing what it was, they ignored it in their haste to get away. Two weeks later, the boat reached Japan. By this time, every man on the boat was desperately sick; all were hospitalized and one man eventually died. Those Japanese fishermen were the world's first casualties from fallout, fallout from a United States multimegaton, surface, nuclear detonation on Bikini Atoll.

In 1954, little was known about fallout; we now know it can kill men and disrupt military operations in areas far outside the zone of blast and heat from a nuclear explosion. The Japanese sailors were not injured by the blast of the nuclear explosion, they were not injured by the heat, they were injured by radioactive fallout, which is the subject of this lesson.

FALLOUT FORMATION, MOVEMENT, AND APPEARANCE

Fallout formation. Nuclear weapons can be defined as air bursts, surface bursts, or subsurface bursts. Of these three, air bursts produce no militarily significant fallout. Only surface bursts, and to a lesser extent subsurface bursts, have the two ingredients which are needed to produce militarily significant fallout. These two ingredients are:

- Fission fragments or, in other words, the leftovers or ashes of the nuclear fission process of the nuclear explosion itself.

- Dirt, which is sucked into the fireball from the crater of the surface or subsurface nuclear detonation.

Militarily significant fallout will be produced only if the white-hot nuclear fireball touches the ground - in other words, in a surface burst or a shallow subsurface burst. The fireball is very hot (millions of degrees Fahrenheit), and it rises rapidly into the air since hot air always rises. In the rapidly rising fireball, if it has touched the ground, are the two ingredients of fallout - the fission fragments of the nuclear explosion and tons of dirt scooped out of the crater.

As it rises tens of thousands of feet into the air, the hot fireball begins to cool and form the typical mushroom shape. When this happens, the very tiny fission fragments become attached to the much larger dirt particles. Eventually, the mushroom cloud ceases to rise; at this time, the dirt particles, with the fission fragments attached to them, begin to sift back to earth as radioactive fallout.

Fallout Movement and Deposition on the Ground

The fallout particles are blown by the winds as they fall; generally they land in an irregular, sausage-shaped area on the ground downwind from ground zero. The larger particles fall faster and land nearer the ground zero. The smaller and lighter particles fall to the ground further downwind so that there is a gradual lessening of the amount of fallout (and therefore the radiation hazard) in areas further downwind from the ground zero.

The winds which determine which way and how far the fallout particles will travel are not the surface winds which we feel on the ground. The mushroom cloud can carry fallout particles up to 100,000 feet into the air (up to 20 miles high). For this reason, it is the winds high above the earth - the "winds aloft" - which largely determine where the fallout particles will hit the ground, not the winds close to the earth's surface.

The falling of the fallout particles back to earth takes time - it does not happen instantly after a surface nuclear explosion. Generally, the fallout particles begin hitting the ground within a few minutes near the ground zero but may not reach the ground for hours in areas many miles downwind. If you are downwind from a surface nuclear explosion, the further away you are the longer it will be before the fallout particles begin reaching the ground in your area.

People in the downwind area of a fallout-producing nuclear explosion will usually see the fallout particles as they begin reaching the ground. It will probably be like being in a dust storm with the fallout particles looking like dust, ashes, or grains of sand. The arrival of the fallout particles will begin slowly; then they will arrive faster and faster for a period of time which can last from minutes to several hours. Eventually, the arrival of the fallout particles will slow down and then stop as the mushroom cloud blows over.

Even from small, tactical-size nuclear weapons, the area contaminated with fallout can be very large. Fallout from a nuclear explosion can cause casualties and disrupt military operations in an area many times larger than the area damaged by the blast and heat of the nuclear explosion itself. The drawings below compare the size of a nuclear weapon's blast and heat damage area to the size of the fallout area for the same yield nuclear weapon. Notice the enormously greater area which can be affected by radioactive fallout.

20 KT SUFRACE BURST

REGION OF COMPLETE DESTRUCTION

WIND DIRECTION

SCALE IN MILES

REGION OF LIGHT DAMAGE
AND SOME FIRES

LIMIT OF SIGNIFICANT
FALLOUT CONTAMINATION

1 MT SURFACE BURST

REGION OF LIGHT
DAMAGE AND SOME FIRES

WIND DIRECTION

SCALE IN MILES

REGION OF COMPLETE
DESTRUCTION

LIMIT OF SIGNIFICANT
FALLOUT CONTAMINATION

At some point in time after a nuclear detonation the NBCC at division or separate brigade will have accumulated enough accurate data to construct a detailed fallout prediction. The prediction will be more accurate than the simplified fallout prediction constructed at unit level. Because unit level commanders require the most accurate assessment of the situation in order to plan and then maneuver, the NBCC will disseminate the detailed fallout prediction as an NBC 3 (Nuclear) Report. To plot an NBC 3 (Nuclear) Report follow the steps provided below:

Plot an NBC 3 (Nuclear) Report

Step #1. Use the correct map scale.

NBC 3 (Nuclear) Report

A NU016
D 150700Z
F PA 484104
Y 00700110
Z 00900601

Step #2. Lay overlay paper on the map and tape it in place.

Step #3. Obtain ground zero (line F of the NBC 3 report) and plot it on the overlay paper. Label it GZ

A NU016
D 150700Z
F PA 484104
Y 007000110
Z 00900601

Step #4. Draw and label grid north from GZ; label it GN as shown below.

Step #5. Obtain the azimuth of left and right radial line from line YANKEE of the NBC 3 report. Draw the radial lines at the azimuths measured from grid north (70° and 110°) as shown below.

A NU016
D 150700Z
F PA 484104
Y 00700110
Z 00900601

NOTE: Line Y may be given in mils. In this case divide the sets of numbers given in mils by 17.8 to find the number of degrees.

Step #6. Obtain the cloud radius from line ZULU of the NBC 3 report. Draw it as shown below. Use GZ as the center of the radius. Cloud radius is the last 2 digits of line Z.

A NU016
D 150700Z
F PA 484104
Y 00700110
Z 00900601

Step #7. Obtain the downwind distance of Zone I from the 4th, 5th and 6th digits of line ZULU. Draw as shown above, GZ is used as center to draw the Zone I arcs. As in simplified prediction Zone II is found by doubling Zone I.

Step #8. Obtain the wind speed from the 1st, 2d, and 3d digits of line Z this will be the H + I line. Draw it as shown below using broken line. Label it H + I on both sides. Time of arrival arcs are not drawn past Z II.

A NU016
D 150700Z
F PA 484104
Y 00700110
Z 00900601

A NU016
D 150700Z
F PA 484104

Map Scale 1:50,000

Step #9. Draw lines to connect the cloud radius to Zone I boundary line as shown above.

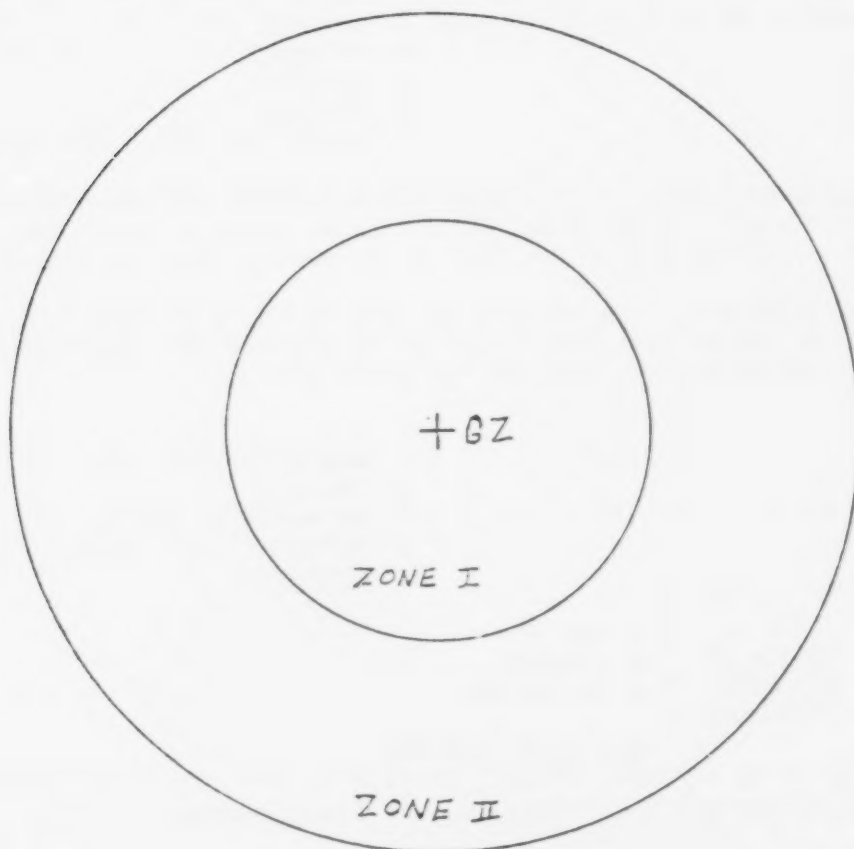
Step #10. Erase all excess lines and write the marginal information near prediction as shown.

Plot NBC 3 (Nuclear Report - Circular Plot)

EXAMPLE: NBC 3 (Nuclear) Report

A NU016
D 180800Z
F PA 511031
Z 002

There are only 3 digits in line Z. The 3 digits are the radial distance of Zone I. Zone II is found by doubling Zone I. In this case Zone I has a radial distance of 2 km. Zone II has a radial distance of 4 km. When plotting, always use the scale of the map that you are posting on. The NBC 3 report is plotted as shown below.



A NU016
D 180100Z
F PA 511031

An NBC 3 (Nuclear) Report is an immediate warning of expected contamination or detailed fallout prediction. Like any prediction it is a best guess of where the contamination from a surface burst will fall. In order to accurately assess the actual area of contamination, the NBCC must be provided Radiological monitoring and survey data. The NBCC will collect this data and construct a contamination overlay depicting the area of actual contamination. To disseminate the overlay the NBCC will format an NBC 5 (Nuclear) Report. This report, when plotted at unit level, will give the commander a graphical depiction of the actual area of contamination.

PREPARE CHEMICAL DOWNWIND HAZARD PREDICTION

CONDITIONS

Given operations map, overlay material, grease pencil, straight edge, compass (or string), protractor, GTA 3-6-3 (revised IAW Ed.5, STANAG 2103) Chemical Downwind Message (CDM), and NBC 1 or 2 (Chemical) report(s).

STANDARDS

Downwind hazard predictions are plotted in accordance with FM 3-3 and are within the tolerance specified in the performance measures.

PERFORMANCE MEASURES

1. Appropriate attack type and case determined with 100% accuracy.
2. Downwind hazard predictions are plotted in accordance with FM 3-3 and are within the tolerance specified below.
 - All distances will be plotted within $\pm$ 200 meters of actual distances.
 - Attack radius will be plotted within $\pm$ 200 meters of actual distance.
 - Lateral limits will be plotted within $\pm$ 2° of actual angle.

REFERENCES

FM 3-3
STP 3-54E2, SM, TASK 031-506-2005 (TBP)

CROSS A CHEMICALLY CONTAMINATED AREA

Determining Type of Attack

The prediction of downwind chemical hazard areas depends on how long the agent is effective, the wind speed, and--for ground contaminating agents--the size of the attack area.

For hazard predictions, all agents are classified as either air contaminating agents or ground contaminating agents.

Air Contaminating Agent (Type A). These are agents which are normally expected to be dispersed as an aerosol or vapor cloud with little or no contamination on the ground. An example of this type of attack is non-persistent nerve agent employed upwind of the target. Air contaminating agents are normally dispersed in ground bursting munitions. Examples are ground bursting artillery shells and multiple rocket launchers. This type of attack is referred to as a "Type A" attack.

Ground Contaminating Agents (Type B). These agents are normally expected to be dispersed in liquid form to contaminate surfaces. Examples of this type of attack are persistent nerve and mustard agents. These are referred to as a "Type B" attack.

Ground Contaminating agents are normally dispersed by aircraft spray tanks, air bursting artillery shells, rockets, missiles, and mines. To predict a downwind hazard area, whether the attack was a Type A or Type B, you need the following information.

NBC 1 - Observers Initial Report - Giving Basic Data.

This report is used by the observing unit to give initial data and subsequent follow-up data for an NBC attack. The NBC 1 report is the most widely used message. All units must be completely familiar with the NBC 1 report format and the information contained in the report in order to quickly and accurately prepare and send it to the next higher headquarters.

NBC 2 - Evaluated Data.

The NBC 2 report is based on two or more NBC 1 reports. It is used to pass evaluated data down to subordinate units. Normally the Division is the lowest level that would prepare NBC 2 reports, however, Brigade and Battalion Chemical personnel may prepare the report if they have sufficient data and are not likely to receive the report from Division in a timely manner.

For chemical attacks, the most important use for the NBC 2 report is to define the type and location of attack. Division NBCC prepares the NBC 2 report, assigns it a strike serial number and disseminates it to the appropriate subordinate unit. Each subordinate unit then decides whether to disseminate the report further. If a unit is not in the attack area, it is not necessary to send a NBC 2 report to the unit.

Chemical Downwind Message

The chemical downwind message (CDM) contains all the weather information needed to calculate a chemical downwind hazard. The CDM is very useful because it provides the local wind speed, wind direction, stability category, and relative humidity in a short concise statement. The CDM is prepared by corps and division NBCCs from information obtained through the US Air Force Weather Service, staff weather officer, or the fleet weather service. The CDM is issued every 6 hours and is valid for 3 consecutive 2-hour periods. The CDM contains the following:

Date-time group for basic data. The time the first forecast is effective. Adding 2 and 4 hours to this time gives the effective times for the other two forecasts.

Area of validity. The area affected by the CDM. It could be a map sheet number, or an area such as Division or Corps.

Air stability category. Describes the projected air stability. It will be one of seven numbers which correspond to stable, neutral, or unstable conditions.

Surface air temperature. The average temperature of the air in the forecast area.

Surface wind speed and direction. The representative wind speed and direction during the forecast period.

Relative humidity. The average humidity for the forecast period.

Significant weather phenomena. Refers to any weather conditions that could affect either the distance the cloud travels or the duration of the agent in the hazard area.

Interpreting the CDM

Division NBCC is usually the lowest level that would prepare a chemical downwind message. Separate brigades may also be required to prepare a CDM when operating independently.

The Air Force weather station (AWS) is the best source for this information. They can provide weather forecasts for division or corps areas. The next step is to break it down into three, consecutive, 2-hour increments. Once this is done, the NBCC translates this data into codes and puts them in proper format. Each forecast line contains 11 digits. The first six digits represent the downwind direction and wind speed. The last five digits represent the air stability, temperature, humidity, and significant weather phenomena. The following is a sample CDM.

CHEMICAL DOWNWIND MESSAGE

110600Z

I CORPS

W	120010	41471
X	125010	41671
Y	130005	51860
	1st	2nd

MESSAGE CONTENTS

Time of Beginning Forecast

Area of Validity (area that CDM effects)

Line W - Represents period of validity for the first two hours (in this case 0600-0800)

Line X - Represents period of validity for the second two hours (in this case 0800-1000)

Line Y - Represents period of validity for the third two hours (in this case 1000-1200)

MEANING OF THE NUMBERS IN LINES W, X, Y.

- Line W - 120 First three digits, representative downwind direction.
010 Second three digits, representative downwind speed in km/hr.
4 First digit in second group of numbers, air stability category.
14 Second and Third digit, surface air temperature in centigrade.
7 Fourth digit, humidity.
1 Fifth digit, significant weather phenomena (cloud cover, snow, fog, rain, haze, etc.).

Field Expedient CDM.

There may be times when a valid CDM is not available from the corps or division NBCC. When this happens, estimate the air stability category by observing local meteorological conditions. The most difficult aspect is determining the angle of the sun by observation. Since most units do not have equipment to do this, make the best estimation possible.

Enter the chart below with the time of day and angle of sun. Then select the applicable sky condition. Read across to where the lines converge and extract the air stability category.

TABLE 1
STABILITY BASIC CHART

TIME OF DAY AND ANGLE OF SUN		CONDITION OF SKY		
		Less than half covered	More than half covered	Overcast
M O R N I N G	$\leq 4^\circ$	S	S	N
	$> 4^\circ$ and $\leq 32^\circ$	N	N	N
	$> 32^\circ$ and $\leq 40^\circ$	U	N	N
	$> 40^\circ$	U	U	N
E V E N I N G	$> 46^\circ$	U	U	N
	$> 35^\circ$ and $\leq 46^\circ$	U	N	N
	$> 12^\circ$ and $\leq 35^\circ$	N	N	N
	$> 5^\circ$ and $\leq 12^\circ$	S	N	N
	$\leq 5^\circ$	S	S	N

Once you have obtained the air stability category from the basic chart, enter the adjustment chart with that category. Select the appropriate weather and terrain condition. Read across to where they intersect and extract the final stability category.

TABLE 2

AIR STABILITY CATEGORY ADJUSTMENT CHART			
WEATHER AND TERRAIN All eight conditions given below must be checked. If more than one applies, choose the most stable category.	STABILITY CATEGORY FROM BASIC CHART		
	U	N	S
Dry to slightly moist surface	U —	N	S
Wet surface (i.e., after continuous rain or dew)	N	N	S
Frozen surface or partly covered with snow, frost, or hoarfrost	N	S	S
Surface completely covered with snow	S	S	S
Continuous rainfall		N	
Haze or mist (visibility 1-4 km)	N	N	S
Fog (visibility less than 1 km)	N	S	S
Downwind speed more than 18 km	N	N	N

Table II is used for adjustment of the stability category found Table I, taking into account influence of surface and weather.

All eight conditions of terrain and weather listed in Table II must be checked and, in case of doubt, the most stable category is to be chosen.

PREPARE A CHEMICAL HAZARD PREDICTION

Plot Type "A" Case "a" - When effective wind speed is 10 kilometers per hour or less.

Step 1. Determine location of attack and plot on map or overlay. (If using an overlay don't forget the two reference marks).

Step 2. Draw a circle with a 1 kilometer radius around this point. The area inside this circle is the attack area.

Step 3. Using the same center, draw a circle with a 10 kilometer radius. The area (between the two circles) is the hazard area. Place the appropriate marginal data (A, D F, & H) on your overlay.

Plot Type "A" Case "b" - When effective wind speed is more than 10 kilometers per hour.

Step 1. Determine the location of the center of the attack and plot on a map or overlay. If using an overlay, draw a Grid North line from this point and mark the two reference points.

Step 2. Using this point as the center, draw a circle with one (1) kilometer radius as before. This area inside this circle is the attack area.

Step 3. From the valid Chemical Downwind Message (CDM), or from locally obtained weather information, determine the air stability category, downwind direction, and wind speed. To determine the air stability category when a valid CDM is not available:

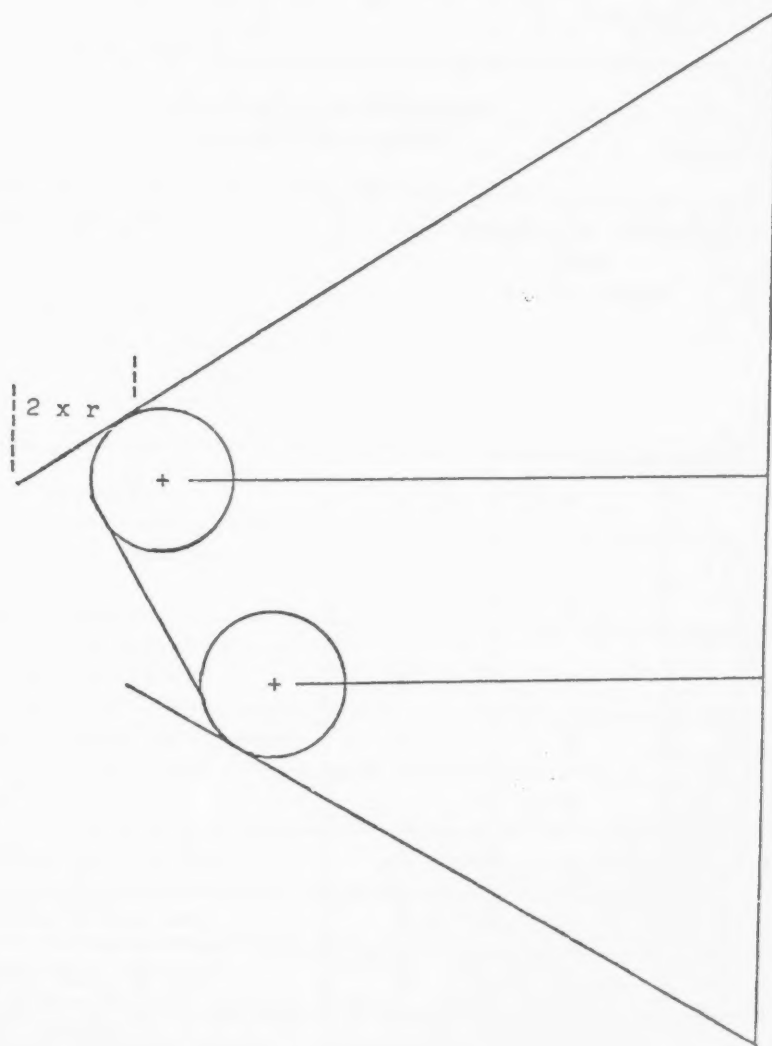
a. Enter The Air Stability Category Basic Chart with time of day and sun elevation angle to obtain stability category.

b. With category obtained in the Basic Chart, enter the Air Stability Category Adjustment Chart, and obtain the "adjusted stability category". Use this result as the air stability category.

Step 4. From the center of the attack area draw a line to represent the wind direction.

Step 5. Enter the Downwind Distance of Hazard Area Table with the appropriate air stability category and the means of delivery to find the maximum downwind distance of the hazard area. Plot this distance from the center of the attack area on the line representing the effective downwind direction. At this point, draw a line perpendicular to, and across the downwind direction line. This line is the maximum downwind hazard distance line.

Step 6. Mark a point two times the radius back (180°) from the center of the attack area along the downwind direction line. Starting from this point, draw a line 30 degrees on each side of the downwind direction line. This line will be tangent to the attack area. Extend the line to intersect with the maximum downwind hazard line.



Step 7. You now have the plot drawn. The area inside this plot, but outside the attack area is the hazard area. Place the appropriate marginal data (A, D, F, & H) on your overlay.

STABILITY CATEGORY ADJUSTMENT
TABLE 2

AIR STABILITY CATEGORY ADJUSTMENT CHART			
WEATHER AND TERRAIN All eight conditions given below must be checked. If more than one applies, choose the most stable category.	STABILITY CATEGORY FROM BASIC CHART		
	U	N	S
Dry to slightly moist surface	U —	N	S
Wet surface (i.e., after continuous rain or dew)	N	N	S
Frozen surface or partly covered with snow, frost, or hoarfrost	N	S	S
Surface completely covered with snow	S	S	S
Continuous rainfall		N	
Haze or mist (visibility 1-4 km)	N	N	S
Fog (visibility less than 1 km)	N	S	S
Downwind speed more than 18 km	N	N	N

Table II is used for adjustment of the stability category found from Table I, taking into account influences of surface and weather.

All eight conditions of terrain and weather listed in Table II must be checked, and, in case of doubt, the most stable category is to be chosen.

TYPE "A" ATTACK
DOWNWIND DISTANCE OF HAZARD AREA

TABLE 3

Means of Delivery	Distance from center of attack area along downwind axis, when the air stability category is:		
	U	N	S
Artillery, Bomblets, and Mortars	10 km	30 km	50 km
Multiple Rocket Launchers, Missiles, Bombs, and Unknown Munitions	15 km	30 km	50 km

NOTE: When no information is available on the nature of the munitions used in the attack, use the figures given for multiple rocket launchers, missiles and bombs.

Type "B" Case "a" - Radius of the attack area is 1 kilometer or less and the wind speed is greater than 10 kilometers per hour. The plot for a Type "B" attack Case "a" is drawn the same as the plot for a Type "A" attack Case "b" EXCEPT the maximum downwind hazard distance for a Type "B" attack is always 10 kilometers. Therefore, the air stability category does not need to be considered. The daily, mean, surface air temperature must be known to determine the probable duration of the hazard (the probable time after contamination that personnel in the area might safely unmask). Enter Table 4, with the daily, mean, surface air temperature and find the probable duration of the hazard in the attack area and the hazard area.

PROBABLE TIME AFTER GROUND CONTAMINATION AT WHICH OCCUPANTS MAY SAFELY REMOVE MASKS

TYPE "B" ATTACK

TABLE 4

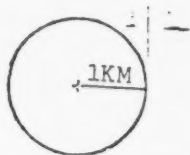
Daily Mean Surface Air Temperature	Within Attack Area (number of days)	Within Hazard Area (number of days)
<0° - 10°C (32-50°F)	3 to 10 days	2 to 6 days
11° - 20°C (51-68°F)	2 to 4 days	1 to 2 days
21° - >30°C (69-86°F)	up to 2 days	up to 1 day

NOTE: Tests for presence of chemical agent contamination and/or proper unmasking procedures must always be used before unmasking after a chemical attack or in any area where a chemical agent hazard might exist.

NOTES: 1. The estimates assume ground contamination densities of up to 10 g/m.
2. In making hazard estimates, vapor has been considered to be the determining factor within the attack area as well as in the downwind hazard area. The duration of hazard from contact with bare skin is, however, difficult to predict. The duration can only be determined by the use of chemical agent detection or confirmation devices.
3. When temperatures are consistently low, the duration of contamination may be longer than indicated in the Table. The absence of vapors does not preclude the presence of contamination.
4. Daily, mean, surface air temperature may be obtained from the local meteorology (MET) officers.

Step 1. Determine the location of the center of the attack and plot on a map or overlay. If using an overlay, draw a grid north line from this point and mark the two reference points.

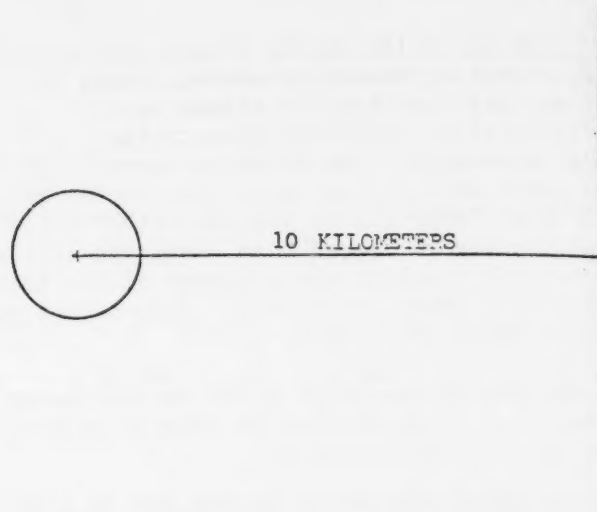
Step 2. Using this point as the center, draw a circle with a one (1) kilometer radius as with a Type "A" case "b". The area inside this circle is the attack area.



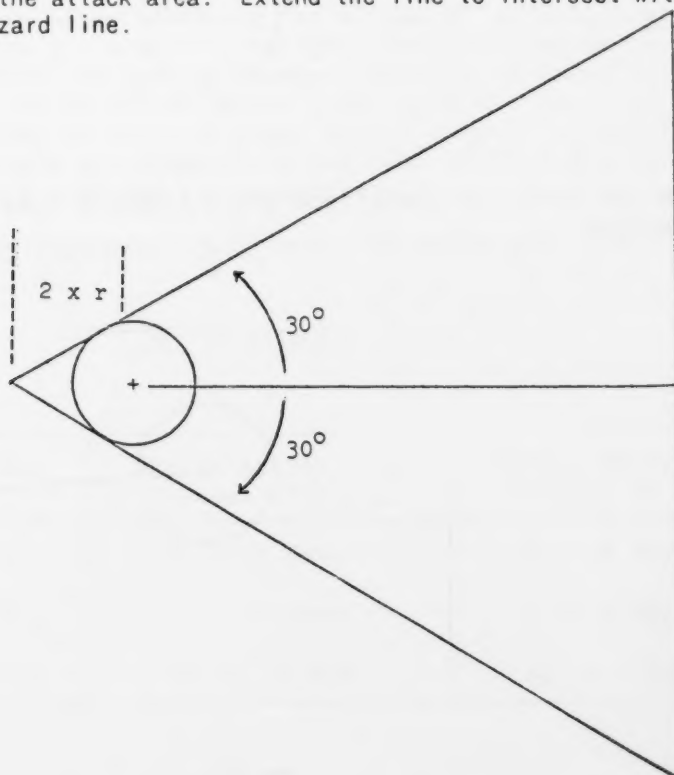
Step 3. From the center of the attack area, extend a line to represent the downwind direction.



Step 4. At this point draw a line perpendicular to and across the downwind direction line 10 kilometers from the center of the attack area. Use the correct scale when using an overlay.



Step 5. Mark a point two times the radius back (180°) from the center of the attack area along the downwind direction line. Starting from this point, draw a line 30 degrees on each side of the downwind direction line. This line will be tangent to the attack area. Extend the line to intersect with the maximum downwind hazard line.

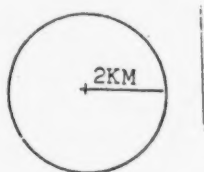


Step 6. You now have the plot drawn. The area inside this plot, but outside the attack area is the hazard area. Place marginal data for the attack (A,D,F, & H) on the overlay.

Plot Type "B" Case "b" - Radius of the attack area is more than 1 kilometer, but less than 2 kilometers and the wind speed is greater than 10 kilometers per hour. For a Type "B" Case "b" attack, a circle with a 2 kilometer radius is drawn to represent the attack area. Everything else is the same as for a Type "B" Case "a".

Step 1. Determine the location of the center of the attack and plot on a map or overlay. If using an overlay, draw a Grid North line from this point and mark the two reference points.

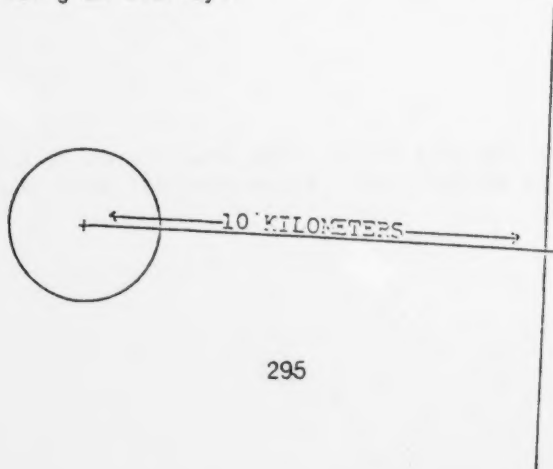
Step 2. Using this point as the center, draw a circle with a two (2) kilometer radius. The area inside the circle is the attack area.



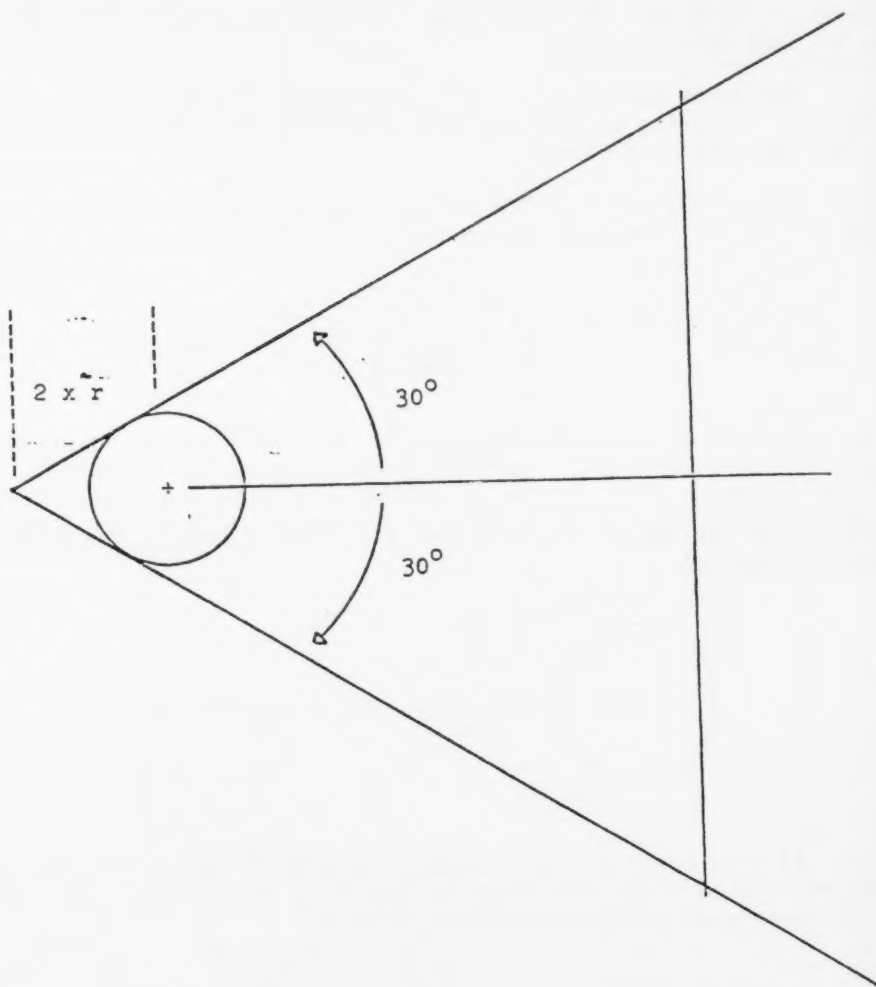
Step 3. From the center of the attack area draw a line to represent the downwind direction.



Step 4. At this point draw a line perpendicular to and across the downwind direction line 10 kilometers from the center to the attack area. Use the correct scale when using an overlay.



Step 5. Mark a point two times the radius back (180°) from the center of the attack area along the downwind direction line. Starting from this point, draw a line 30 degrees on each side of the downwind direction line. This line will be tangent to the attack area. Extend the line to intersect with the maximum downwind hazard line. Remember, for this case, the radius of the attack area is 2 kilometers, therefore, your tangent reference point is 4 kilometers from the center of the attack.



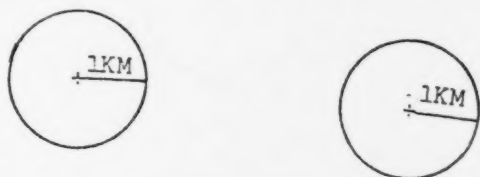
Step 6. You now have the plot drawn. The area inside this plot but outside the attack area is the hazard area. Place marginal data (A,D,F, & H) for the attack on the overlay.

Plot Type "B" Case "c" - Radius of the attack area is 2 or more kilometers and the wind speed is greater than 10 kilometers per hour.

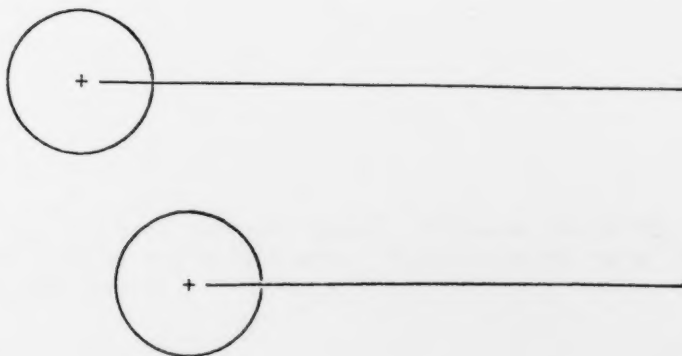
Step 1. Plot the extreme edges of the attack area on a map or overlay. If an overlay is used a Grid North line must be drawn from the most downwind of these two points, and two reference points established.

NOTE: If the attack is a spray attack, the extreme edges will be the beginning and end of the spray(s). If the attack is from several artillery units, two or more NBC 1 or NBC 2 reports may have to be used.

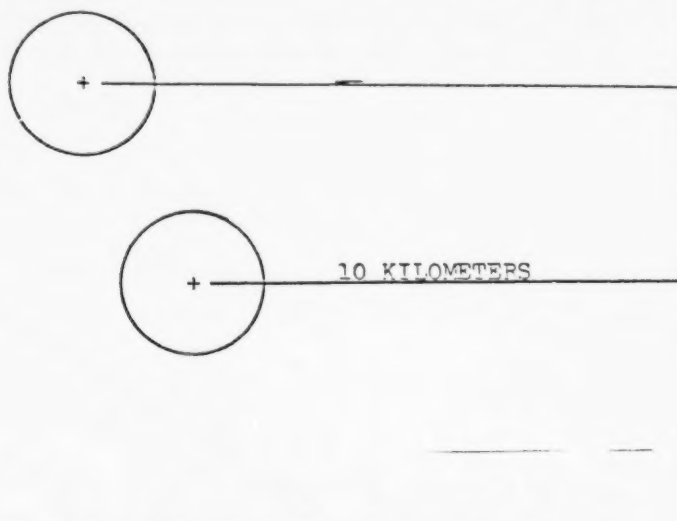
Step 2. Using these two points as centers draw two circles (one at each point) with a 1 kilometer radius.



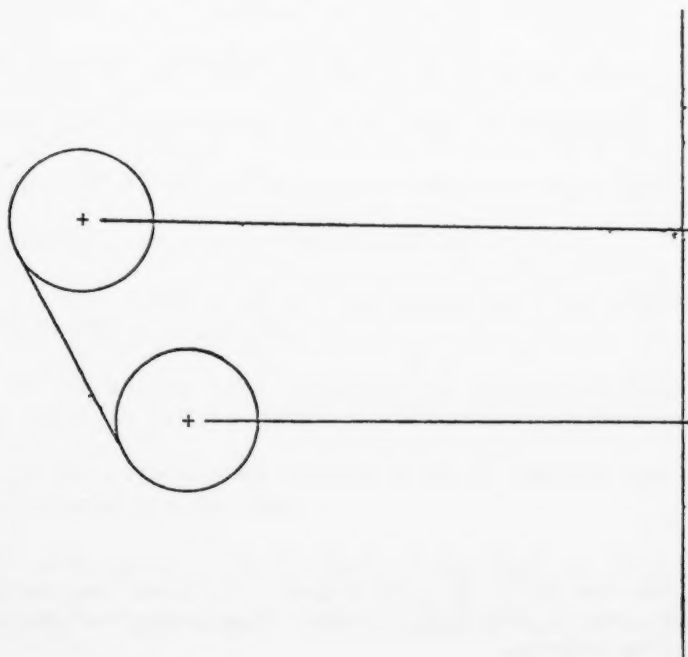
Step 3. From the center of these two areas, draw in the downwind direction lines.



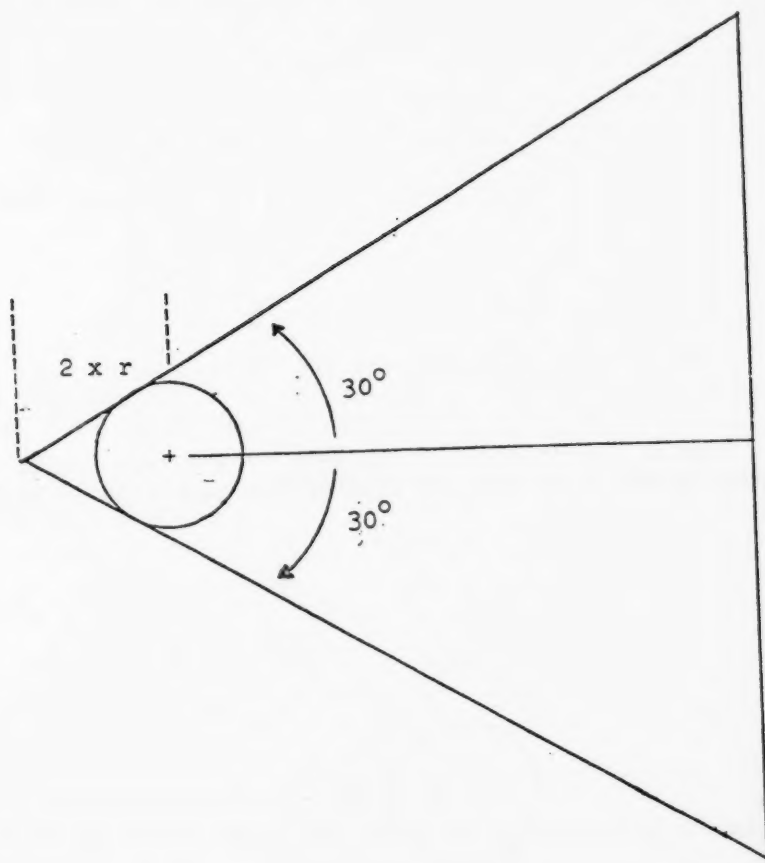
Step 4. Measure the 10 kilometer downwind hazard distance along the downwind direction line from the center of the most downwind circle. Draw a line at this point, perpendicular, to the downwind direction line. This is the maximum downwind hazard distance line.



Step 5. Draw a line to connect the back of the two circles. This line should be tangent to the outer most portion of the back side of each circle.



Step 6. Draw the tangents (radial lines) to the outer edge of each circle. These lines are 30 degrees from a point two times the radius upwind along the downwind direction lines as before.

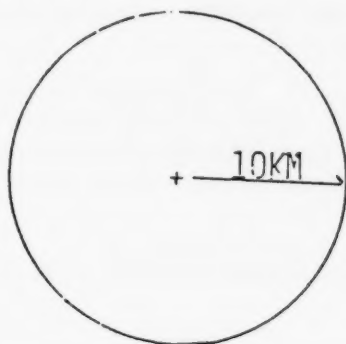


Step 7. You now have the plot drawn. The area inside this plot but outside the attack area is the hazard area. Place marginal data (A,D,F,&H) for the attack on the overlay.

Type "B" case "d" - The effective wind speed is 10 kilometers per hour or less.

Step 1. Determine the center of the attack area.

Step 2. Draw a 10 kilometer circle around the attack area using the center of attack. The area inside this circle is the hazard. The size of the attack area will be undetermined until survey or reconnaissance data are available.



Step 3. You now have the plot drawn. The area inside this plot but outside the attack area is the hazard area. Place marginal data (A,D,F,&H) for the attack on the overlay.

SUMMARY

TYPE A ATTACK - Disseminating an air contaminating agent.

CASE "A" - When effective wind speed is 10 kilometers per hour or less.

CASE "B" - When effective wind speed is more than 10 kilometers per hour.

SPECIAL NOTE: Assume Type "A" attack unless it is known to be a Type "B".

TYPE B ATTACK - Disseminating a ground contaminating agent.

CASE "A" - Radius of the attack area is 1 kilometer or less and the wind speed is greater than 10 kilometers per hour.

CASE "B" - Radius of the attack area is more than 1 but less than 2 kilometers and the wind speed is greater than 10 kilometers per hour.

CASE "C" - Radius of the attack area is 2 or more kilometers and the wind speed is greater than 10 kilometers per hour.

CASE "D" - When the wind speed is 10 kilometers per hour or less.

SPECIAL NOTE: When the size of the attack area is unknown assume a Type "B" Case "b" attack.

Simplified Hazard Prediction

The simplified hazard prediction provides subordinate units a quick and easy method to determine whether or not they are in a chemical downwind hazard area. Since Type A attacks present the greatest hazard, the simplified procedures are based on that type of attack. It is valid until an NBC 3 report is received from higher headquarters.

All that is needed for a unit to make a simplified prediction is a chemical downwind message and a simplified template. The template can be made out of acetate, overlay paper, or plastic.

Procedures:

- Step 1. Extract the wind speed from the CDM. If it is less than 10 km/hr, use the circular portion of the prediction. If it is greater than 10 km/hr follow the remaining steps.
- Step 2. Extract the wind direction from the CDM. Mark that direction on the compass circle of the template.
- Step 3. Extract the air stability code from the CDM then use this code (U, N, or S) to determine the downwind distance.
- Step 4. Place the template on the map with the attack center of the prediction over the actual attack center, and rotate the predictor until the downwind direction is pointing toward grid north.
- Step 5. Draw the downwind line perpendicular to the downwind direction using the distance obtained in Step 3.

Adjusted Hazard Prediction

The methods previously discussed are based on the assumption that the environmental conditions would not change. When changes in weather occur, the downwind hazard prediction no longer applies. An adjusted NBC 3 report may be sent to units/installations in the new hazard area if the recalculation time and transmission time still allow a timely warning. Units no longer in the hazard area will also be notified.

Significant weather changes are:

- ° Change in air stability category.
- ° Change in downwind direction by 30 degrees or more.
- ° Change in the downwind speed to either above or below 10 km/hr.

Recalculation Procedure

The first step is to determine the geographical center of the frontline of the traveling cloud at the time the new data becomes available. This distance is calculated by multiplying the original wind speed by two times the length of time (hours) since the attack. The center of the cloud front is then considered to be the new center of attack area. Once the new center of attack is determined, the downwind hazard area is determined using the procedures outlined for that type of attack.

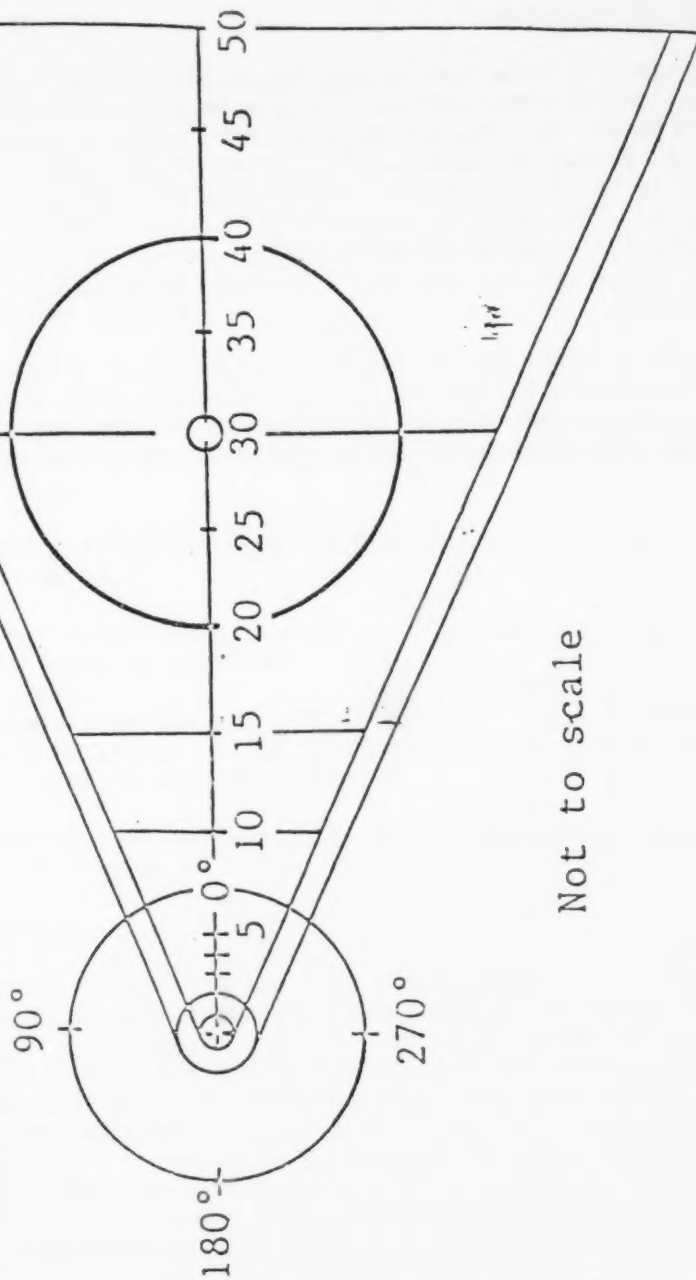
Time of arrival

The earliest an agent can be expected to arrive at a location is determined by dividing the distance from the attack center by twice the wind speed. For example if you are 10 km from the attack center and the wind speed is 5 km/hr, the earliest the agent cloud would arrive at your location would be 1 hour.

$$\frac{10 \text{ kilometers}}{(2 \times 5 \text{ kilometers/hour})} = 1 \text{ hour}$$

SIMPLIFIED CHEMICAL DOWNWIND HAZARD PREDICTOR

Means of Delivery	Distance from center of attack area along downwind axis, when the air stability category is:			
	U	N	S	
Artillery, Bomblets, and Mortars	10 km	30 km	50 km	
Multiple Rocket Launchers, Missiles, Bombs, and Unknown Munitions	15 km	30 km	50 km	



PLOT NBC 3 (CHEMICAL) REPORT

CONDITIONS

Given NBC 3 (Chemical) report, map with overlay material, grease pencil and protractor with the requirement to plot NBC 3 (Chemical) reports.

STANDARDS

NBC 3 Chemical Reports are plotted in accordance with FM 3-3 and are within tolerances specified in the performance measures. Marginal data reflects at a minimum the following: Line ALPHA, DELTA, FOXTROT, HOTEL, and scale of the map used.

PERFORMANCE MEASURES

1. Accurately interpret NBC 3 (Chemical) report.
2. Grid coordinates are plotted on map/overlay within 200 meters.
3. Grid coordinates are connected.
4. Radius of circular plots is plotted on map/overlay within $\pm$ 200 meters.
5. Marginal information is posted on overlay.

REFERENCES

FM 3-3
STP 3-54E2, SM, TASK 031-506-2003 (TBP)

PLOTTING AN NBC 3 (CHEMICAL) REPORT

Because of the potential casualty-producing effects of chemical agents, it is critical that all units within the downwind hazard area be warned as rapidly as possible of the existing hazard.

The NBC report used to warn friendly units of an expected or predicted chemical hazard is the NBC 3 (Chemical) Report. Division NBCC uses the NBC 1 reports and wind information to predict the downwind hazard area. This is disseminated as an NBC 3 report. It is sent to all units that are effected by the hazard. Each unit evaluates the NBC 3 and determines which of its subordinate units is affected and distributes the report accordingly. Units within the chemical downwind hazard area adjust their MOPP level, if necessary, and ensure that chemical agent alarms are placed sufficiently upwind to provide adequate warning.

The NBC 3 report is a prediction which may not be the same as the actual area of contamination. Commanders should use the report when considering courses of action.

Heading of the NBC 3 (Chemical) Report

The heading of the NBC 3 (Chemical) Report consists of the following information:

Precedence. The precedence for the NBC 3 (Chemical) Message is normally IMMEDIATE, however, this message may be downgraded as required or by SOP.

Date/Time. The date and time that the message is sent can be shown in either local or ZULU time; however, it must be stated which time is used.

Security Classification. Normally, the NBC 3 (Chemical) Report is UNCLASSIFIED.

From. This line contains the designation of the agency preparing the report.

To. This line contains the designation of the unit or units to which the message is being sent.

Type of Reprot. NBC 3 (Chemical) Report will be entered in this line.

Body of the NBC 3 (Chemical) Report

The information contained in each line of the body of the NBC 3 (Chemical) Report is as follows:

<u>Line Item</u>	<u>Meaning</u>
ALFA	This line contains the strike serial number that was assigned to the attack by the NBCC upon receipt of the Initial NBC 1 (Chemical) Report.
DELTA	The date and time of the attack in either local or ZULU time is entered in this line.
FOXTROT	This line is used to give the location of the attack. The location can be given in a set of map coordinates or as a place, such as the name of a town, bridge, community, ec. Regardless of what method is used to identify the location of the attack, it must be stated whether the location is the actual location of attack or an estimated location of attack.
HOTEL	This line identifies the type of chemical agent employed.
PAPA ALPHA	This line is either provided as a set of grid coordinates or if the wind speed is 10 km/hr or less, three digits giving the radius of the circular plot.
PAPA BRAVO	This line describes the duration that the hazard can be expected on both the attack area and hazard area.

YANKEE

This line provides the downwind direction, four digits, in degrees or mils, and the wind speed, three digits, in kilometers per hour or knots. The units of measure must be stated. This data is required to calculate estimated time of arrival of the agent cloud.

ZULU ALPHA

This line provides the temperature in centigrade, two digits; cloud cover, one digit; significant weather phenomena, one digit; and air stability, one digit.

When properly prepared, a typical NBC 3 (Chemical) Report will appear as follows:

NBC 3 (CHEMICAL) REPORT

Precedence: IMMEDIATE
Date/Time: 211900Z
Security Classification: UNCLASSIFIED
From: R2T07
To: N3B15
Type of Report: NBC 3 (CHEMICAL)
ALFA: 81D001
DELTA: 211800Z
FOXTROT: NV873315 ACTUAL
HOTEL: NERVE
PAPA ALPHA: NV873320
 NV892338
 NV892260
 NV873310
PAPA BRAVO: In attack area - 2-4 days.
 In hazard area - 1-2 days.

YANKEE: 0270° 015 km/hr

ZULU ALPHA: 15154

Plotting an NBC 3 (Chemical) Report

Step 1. Plot the location of the attack (center of the attack area) from line FOXTROT. If using an overlay draw a Grid North line and mark two reference points.

Step 2. If line PAPA ALPHA contains three digits, for example "010", draw a circle with a 10 kilometer radius, using the above point as the center.

Step 3. If line PAPA ALPHA contains grid coordinates simply plot each coordinate and connect the dots.

Step 4. Copy the marginal data from the report.

NBC DEFENSE EQUIPMENT READINESS

The old concept of a unit "NBC Room" is obsolete. The totally combat ready unit must have NBC equipment (along with appropriate Technical Manuals) issued to the soldier to ensure operator training in the use and maintenance of NBC equipment.

The time required to issue protective masks, chemical protective clothing, decontaminants, and team equipment is prohibitive to unit readiness. Also, supply sergeants must be trained to recognize NBC equipment resupply as an area for which they are responsible. There is no single class of supply denoted as NBC in the current ADMF. One individual and team equipment is in the hands of the troops, the majority of repair parts are placed in parts bins as PLL/ASL, leaving only training items for the NBC NCO to contend with. Storage is accomplished IAW appropriate TMs and Regulations.

NBC readiness is ensured through regular training, SOP, and by keeping NBC equipment accessible, maintained, and resupplied as required.

Prior to mass issue of all NBC equipment to individuals or at least in platoon/section consolidated equipment boxes, the commander must ensure all property accountability procedures, maintenance procedures, and scheduled maintenance is understood. All first line supervisor must be trained. First line supervisors are the cornerstone to success to this type of NBC equipment readiness program. Once commanders are confident that first line supervisors are competent and understand their role in the sustainment of this equipment, the old concept of "NBC Room" can be disestablished.

Maintenance Operations

Maintenance involves all actions taken to keep material in a serviceable condition. A successful maintenance program is dependent upon the concentrated efforts of all personnel of the unit. Part of your job will be to ensure that proper maintenance records and procedures are kept and performed.

Preventive Maintenance

Preventive maintenance is the keystone to a good maintenance program. Preventive maintenance includes systematic servicing, inspection, correction of initial failures before damage occurs, detection and correction of abuse, and teaching proper care and use of equipment. Early and thorough preventive maintenance prevents minor shortcomings from becoming major deficiencies which require extensive repair. Preventive maintenance must be scheduled at definite intervals, as the tactical situation allows. You can anticipate periodic announced and unannounced inspections and spot checks to be conducted by company and battalion. You should perform your own checks to ensure the program is working for NBC equipment.

Preventive maintenance is facilitated through the use of appropriate maintenance records. These records are a thorough control device for the

recording of operating condition, maintenance accomplished, and modification of various items of equipment. Maintenance records provide the commander with current information on:

Equipment operational status

Results of inspections

Scheduling of preventive maintenance services

Keeping proper records permits the selection of equipment which requires the greatest maintenance effort. It also aids in development of priorities for turn-in when replacement items are available, thus enhancing the capability of the unit to effectively accomplish the mission.

NBC EQUIPMENT MAINTENANCE OPERATIONS

One of the responsibilities you will have as an NBC Officer or NCO is to maintain the unit NBC equipment. You will need to maintain certain maintenance forms to keep your equipment operational. DA PAM 738-750 provides you the information on preparing these maintenance forms. The forms you will need to maintain are:

- a. DA Form 2404, Equipment Inspection and Maintenance Worksheet
- b. DA Form 2407, Maintenance Request
- c. DA Form 2408-9, Equipment Control Record
- d. DD Form 314, Preventive Maintenance Schedule and Record

Equipment Inspection and Maintenance Worksheet, DA Form 2404. - The purpose of the DA Form 2404 is to record equipment faults found during the operator's inspection, periodic preventive maintenance checks and services (PMCS), inspection of equipment by maintenance activities, diagnostic checkouts, and spot check inspection of equipment.

When completed by an equipment operator or crew, it is used to report any faults that cannot be corrected by the operator or crew and any faults that are corrected by replacing parts.

When completed by organizational maintenance it is used for recording periodic maintenance services, all faults found and the corrective actions taken as a result of the inspection. The preparation of this form is fairly simple and may vary with the purpose for which it is being used.

Maintenance Request, DA Form 2407. The purpose of the DA Form 2407 is to request maintenance and modification work order (MWO) support from higher level maintenance activities. Additional use of this form can be found in DA Pam 738-750.

Equipment Control Record, DA Form 2408-9. The purpose of the DA Form 2408-9 is to give maintenance managers at all level the means of getting initial basic equipment acceptance and identification information for selected items in the Army inventory. It also gives the means for updating information on ownership, location, usage, transfers, gains, losses, overhaul, rebuild, and disposition.

Preventive Maintenance Schedule and Record, DD Form 314. This form is used to record scheduled and performed periodic services on equipment. When specified by the technical manual, services will be performed by organizational personnel or under the supervision of organizational personnel. One DD Form 314 may be initiated for each item of equipment, however, several like items may be scheduled on one 314 if they are scheduled for service on a common date.

NBC SUPPLY PROCEDURES

Understanding how the supply sysem works can increase the NBC Officer/NCOs ability to directly influence his/her unit NBC readiness. An individual does not have to be an expert Supply Officer or NCO. However, he or she must know the fundamentals of supply procedures to ensure that all equipment not on-hand is on order, and that required repair parts are stocked or are routinely ordered.

There are two people an NBC Officer/NCO has to become acquainted with in order to accomplish those supply actions that are required to properly maintain the unit equipment and supplies. They are the Unit Supply Specialist (Supply Clerk) and the Prescribed Load List (PLL) Clerk. AR 611-201 describes the duties and tasks that are required for a Supply and PLL Clerk. Listed below is an excerpt from that regulation stating those tasks Supply and PLL clerks accomplish that directly effect supply procedures for NBC Room equipment procedures.

MOS 76Y, Supply Clerk. Prepares request and turn-in documents. Processes supply requests. Prepares, reviews, and corrects hand receipt property listings and annexes. Posts transactions to record of demand. Prepares clothing and equipment records. Prepares abstract of organizational clothing and equipment. Prepares inventory adjustment document.

MOS 76C, PLL Clerk. Maintains equipment records and repair parts lists, and performs maintenance control duties. Performs PLL/SSL duties in manual and automated supply systems. Requests initial prescribed load list from support activity, or develops and submits proposed PLL/SSL using catalog data and technical manuals. Identifies repair parts and prepares requests for issue or turn-in. Receives, stores, and issues repair parts. Prepare PLL/SSL change listings based on usage records maintained. Uses status cards and reconciliation listing to update due-in records. Prepares request for cancellation or follow-up.

ARMY MASTER DATA FILE (AMDF)

The Army Master Data File (AMDF), on microfiche, provides recipients with the most commonly used supply management data for more than one million stock numbered supply items authorized for Army use.

Both the Supply Clerk and the PLL Clerk use the Army Master Data File (AMDF) in selecting data for requests for issue and turn-in. The AMDF is used at all levels of supply activities for identification and validating data used for preparation of request for issues or turn-in of supplies. The ability to properly use the AMDF will enhance the NBC Officer and NCOs ability to ensure that the requisitions initiated for NBC readiness are accurate and properly filled out. The Code Reference Guide, CDA Pam 18-1, Aug 81 provides instructions and guidance on the use of the AMDF Microfiche File. It contains definitions and explanations of all codes appearing in the microfiche file.

The system is not designed for NBC Officers and NCOs to be required to fill out requisitions (DA Form 2765). Instead NBC Officers and NCOs should identify shortages, list them on a DF, and submit to the commander for approval. This list then, when approved, is given to the Supply Clerk or PLL Clerk and they requisition the equipment or repair parts on a DA Form 2765 or 2765-1.

If you attempt to submit a requisition, you must ensure you do it correctly. Any errors on the DA Form 2765, Request for Issue or Turn-in, will invariably cause delays in obtaining required part or supplies. Proper use of the AMDF using CDA Pam 18-1 will ensure that your requisitions are completed properly. In either case, on all requisitions you need to check the National Stock Number (NSN), item description, unit of issue, and price. You might also be prepared to provide the authorization document (CTA or TM with date) depending on what you are ordering.

PRESCRIBED LOAD LIST (PLL)

NBC Officers and NCOs should closely inspect for broken or missing parts on their equipment. They should be able to produce document numbers for these parts if required. Those immortal words, "Sir, it's on requisition", just do not carry the same authenticity as a valid document number. By ensuring that parts are on a valid request, we help the system to function properly. The system must know what we need in order to support us. Excess repair parts are a serious problem in many units. Excess parts are generated for many reasons. Units order too many parts, order the wrong part, fail to install requested parts, scrounge more than they need, and so on. These parts usually sit in wall lockers, desks, CONEXs, or closets in a disorganized heap.

A tradition has developed that seems to say a unit must have large quantities of excess parts on hand to do well in maintenance. Yet, those units that do not allow excess parts to accumulate in every nook and cranny usually have an effective maintenance program. Why? Because they have developed skill at using the supply system and understand that excess parts do not mean effective maintenance.

MANDATORY PRESCRIBED LOAD LIST (MPL)

The Army has begun phasing in a program to establish standardized combat prescribed load lists (PLLs) and authorized stockage lists (ASLs) designed to make peacetime demand-supported PLLs and ASLs more "combat ready". The program was initiated in response to concern expressed by Army commanders over the capability of present PLLs and ASLs to meet combat needs. Since current PLLs and ASLs are based mostly on peacetime demands, they do not take into account increased wearout rates or damage associated with combat.

The intent of the program is to improve repair parts stockage in Army units so that equipment can be maintained during combat and to standardize the combat PLLs and ASLs of similar units as much as possible. To assist units in the task of establishing combat PLLs and ASLs, the Army has published DA Pamphlet 710-3, which introduces the program, and DA Circular 700-81-2. The circular explains the methods used to determine the makeup of the lists and establishes the program responsibilities of the major commands. It also contains a user's guide for requisitioning and maintaining combat stockage lists.

A mandatory stockage of repair parts needed to perform combat essential battlefield maintenance should be in PLL/ASL at all times. The Army Standardized Combat PLL/ASL Program improves repair parts stockage in Army units so that units can continue to operate in combat. The PLL is based on peacetime demands that will not support units during war. To overcome this shortage, DA is publishing mandatory parts lists (MPL) in DA Pamphlets for each type unit table of organization and equipment (TOE). MPLs list the equipment and repair parts that the unit must stock. Not all end items found on a unit TOE will be provided with an MPL. Only those end items critical to the unit's mission will be provided in an MPL. In addition to MPL, units will stock command essential list (CEL) parts (i.e., demand supported and command unique, combat essential repair parts). Units must eliminate combat nonessentials.

Combat PLL (i.e., MPL and CEL) is limited to 300 lines. If adding the MPL items pushes the unit total number of on hand lines above 300, the PLL will have to be purged. The recommended sequence for purging items is to delete nonessential items first (Army master data file (ADMF) code G); next, to delete deferrable maintenance items (AMDF code J); and finally to eliminate legal and safety items (AMDF codes D and E).

DA has published 49 MPL pamphlets for the Army Standardized Combat PLL/ASL program. Twenty-two of these pamphlets were published 1 March 1983. Another 11 pamphlets were prepared and were scheduled for distribution in August 1983. These 60 pamphlets complete the TOE for Tank and Mechanized Infantry Divisions. Other TOE MPL pamphlets will be completed according to HQDA priority specifications.

We've discussed that NBC Officer/NCOs do not have to be supply experts in order to ensure NBC readiness. However, it is essential they understand how the supply system works. We've discussed who to go to when you need equipment and repair parts. We've discussed where to research your supply management data and the reference you need to use the ADMF. We've discussed that the NBC

Officer/NCO is responsible for ensuring that repair parts are maintained or are on order, but not kept in excess. We've briefly discussed what PLL is and that now the Army is implementing a Mandatory PLL for all units.

Property Accountability. When you are assigned the duties as an NBC Officer or NCO, your commander may have you sign for all the NBC equipment assigned to the unit. This equipment costs the military a great deal of money if you should lose it. There are times when you must loan your equipment to another person or unit. To ensure accountability you will need a DA Form 2062. This form, when filled out properly, will transfer the responsibility for the item over to the other person or unit who is receiving it.

Assuming that the commander decides to issue all unit NBC equipment to the individuals responsible (i.e., squad leaders and platoon sergeants) the use of the DA Form 2062 is critical. Without proper accountability, determining liability when equipment is damaged or lost becomes very difficult.

USE AND MAINTAIN IM93 OR IM147 DOSIMETER
AND PP1578 CHARGER

CONDITIONS

You are given an IM93 or IM147 dosimeter, and a PP1578(*) RADIAC detector charger. The appropriate operator's technical manual (TM) or extract for the dosimeters and charger is available for preventive maintenance checks and services (PMCS) only. You are also given denatured alcohol; water; mild detergent; brush; lint-free cloth; and a light source.

STANDARDS

1. PMCS is performed on the dosimeter and charger.
 - a. All deficiencies/shortcomings correctable at operator level are identified and corrected.
 - b. All deficiencies/shortcomings not corrected are reported to the supervisor.

NOTE: Uncorrected deficiencies/shortcomings must be recorded on DA Form 2404 IAW DA Pam 738-750. However, this is not a performance measure of this task.

2. The dosimeter is charged to zero.
3. The total dose is determined within the following accuracy:
 - a. ± 5 rad(cGy) for the IM93.
 - b. ± 1 rad(cGy) for the IM147.

PERFORMANCE MEASURES

1. Performs PMCS on dosimeter.
2. Performs PMCS on charger.
3. Charges the dosimeter to zero.
4. Reads total dose from the second dosimeter.
5. Completes task within ten minutes.

REFERENCES:

FM 21-3, Task 031-503-2001
FM 3-54E1/2, Task 031-505-1013

UNIT RADIAC EQUIPMENT

In the event that nuclear warfare on either tactical or strategic scale should ever be initiated, proficiency in the use of unit RADIAC equipment for the detection and measurement of radiation dosages and dose rates will be essential for survival. To read and report radiation dosages you must be proficient with dosimeters. This requires a knowledge of their purposes, characteristics, total dose range, procedures for placing dosimeters into operation, methods of reporting radiation dosages, and the operators maintenance required on dosimeters and chargers.

Dosimeters are designed to measure the total dose of nuclear radiation (gamma rays) received by an individual.

Dosimeters are a group of radiacmeters which measure the cumulative short duration exposure to high intensity gamma rays. Gamma radiation is pure energy which travels through space in a straight line at the speed of light. Gamma rays are invisible rays similar to X-rays. Gamma rays interact with the human body and cause damage to tissues and the blood-forming cells. It is these effects on the body that are of significant concern to the commander. The commander must know the total dose of nuclear radiation received by individuals in the units. This will permit the commander to more effectively employ the command on the nuclear battlefield. The main source of this nuclear radiation is fallout.

Characteristics.

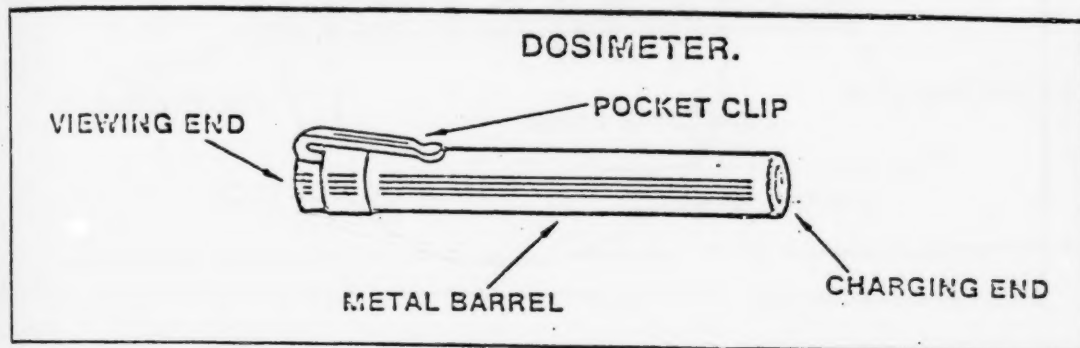
There are four models of dosimeters: IM9E/PD, IM93/UD, IM93A/UD, and IM147/PD. The IM9E/PD will not be discussed, they are primarily used in laboratories or areas that produce low levels of radiation.

IM93/UD and IM93A/UD. These dosimeters are considered the standard tactical dosimeters. They are issued on the general basis of two per platoon. The readings received at this level form the basis for controlling the exposure of personnel on the nuclear battlefield.

IM147/PD. This dosimeter is issued to radiological survey and monitoring teams. It permits the teams to determine when the turn-back dose has been reached. The survey/monitoring teams will receive more radiation than other soldiers who are not on the team. The total dose for this team is controlled.

The total dose status of the team is a matter of interest to the Nuclear, Biological, Chemical Element (NBCE). It is one of the measures used by the NBCE in selecting which unit teams are to perform surveys.

All models are self-indicating (direct reading) pocket dosimeters. They are a hermetically sealed assembly in a metal barrel.



Optical System. The optical system consists of an eyepiece lens and an objective lens. The eyepiece lens gives a magnified view of the calibrated scale. The objective lens gives a greatly magnified view of the shadow of the indicating fiber.

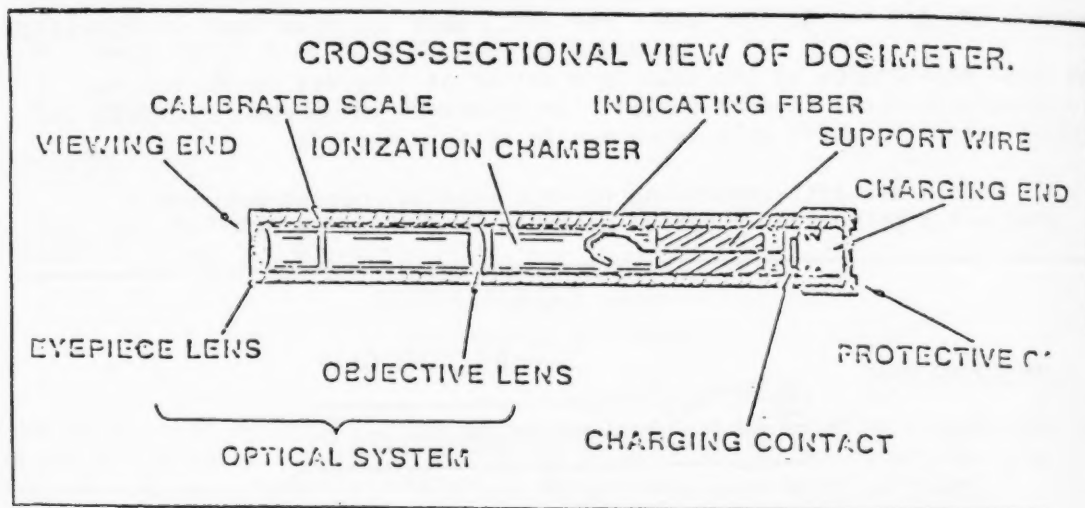
Charging End. Light enters the dosimeter through the charging end and illuminates the field of view.

Protective Cap. A protective cap is fitted over the charging end to prevent foreign matter from entering the charging end. If the cap is made of a clear material which allows light to pass through, the dosimeter may be read with the cap on. When the cap is made of any other material, the cap must be removed to take a reading. If the protective cap is lost or defective, it must be replaced with clear cellophane tape or similar material.

Charging Contact. The charging contact allows the dosimeter to be charged using a Charger RADIAC Detector. This item will be referred to as a charger for the remainder of this lesson.

NOTE

Some IM93/UD and IM93A/UD dosimeters may have the word RAD instead of the word ROENTGENS stamped on their calibration scale. The term RAD can be substituted for ROENTGEN if rad measurements are required. The term cCy(rad) is used in this lesson.



Total Dosage Range.

The IM93/UD and IM93A/UD have the same scale. These dosimeters will measure nuclear radiation on a scale from 0 to 600 cGy(rad). The IM147/PD has a similar scale except it measures from 0 to 50 cGy(rad) only.

IM-93/UD AND IM-93A/UD
CALIBRATED SCALE.



IM-147/PD CALIBRATED SCALE.



The total dosage range for each of the three dosimeter models is indicated below:

IM 93 UD	0 to 600 cGy(rad)
IM 93A UD	0 to 600 cGy(rad)
IM 147 PD	0 to 50 cGy(rad)

Charge a Dosimeter. The dosimeter must be charged before it is put to use. It also must be charged whenever it becomes discharged because of leakage or exposure to radiation. The dosimeter should be charged in a dust-and-radiation-free area, if possible. When the dosimeter is charged, it should not be subjected to severe shocks, excessive dampness, or high temperatures. Chargers are issued on a basis of one per four dosimeters, but no more than five nor less than two, per company-size unit.

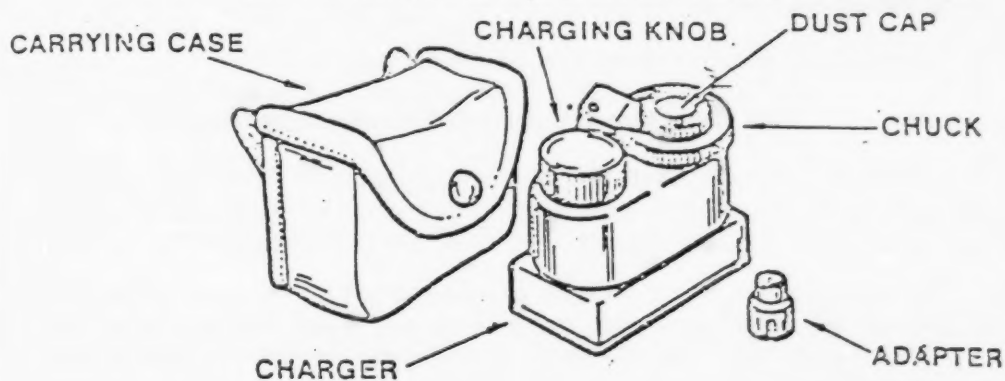
Description. There are two models of the Charger, RADIAC Detector: the PP1578/PD and the PP1578A/PD. The PP1578A/PD charger is the newer model. The difference between the two models is the improved ease of operation of the new model. The Charger, RADIAC Detector will be referred to as the charger throughout this lesson.

Charger, RADIAC Detector PP1578/PD. The charger consists of mechanical and electrical parts enclosed in a watertight metal case. Mounted on the top of the case is a rotatable charging knob. Also on top of the case is a charging socket with a chuck mechanism that secures the dosimeter during charging. A dust cap is secured to the case by a bead chain. (An adapter that permits the charger to be used to charge United Kingdom dosimeters is stored in the carrying case). A circular glass window in the bottom of the case admits light to the bottom of the charging socket. This illuminates the calibrated scale of the dosimeter during charging. A cloth carrying case encloses the assembled charger, adapter, and dust cap. Metal hooks on the back of the carrying case permit the charger to be attached to the belt of the operator.

Charger, RADIAC Detector PP1578A/PD. This charger is the newer model and is easier to operate. A charging pedestal is provided instead of a charging socket. The chuck mechanism has been eliminated. The charging knob is located on the side of the case. A prismatic lens system directs light from the window to the bottom of the charging pedestal. The adapter, when not in use, is stored in a separate cylindrical container. An elastic strap secures the adapter container in the carrying case.

Common Features of Both Chargers. Both charger models have the same control, which is the charging knob. Clockwise rotation of the charging knob generates a positive charge. Counterclockwise rotation of the charging knob generates a negative charge.

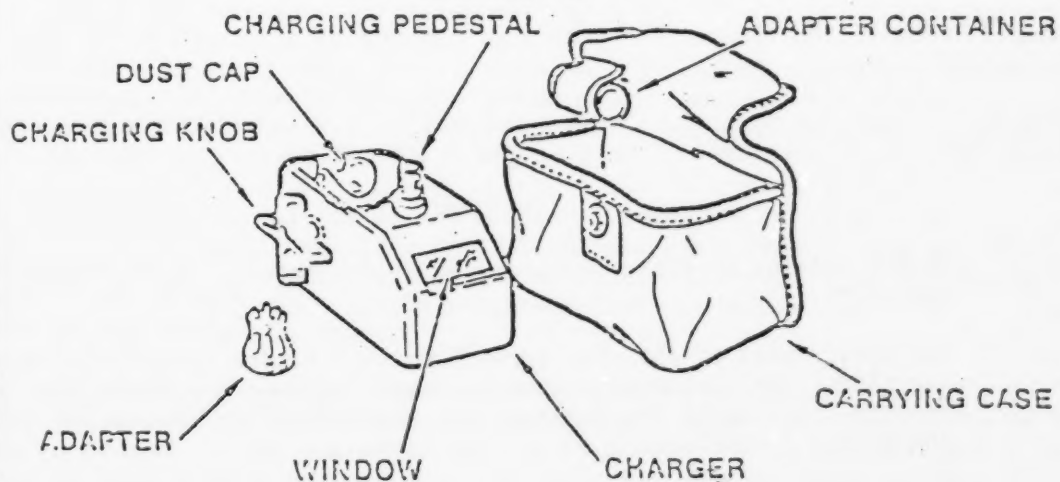
CHARGER, RADIAC DETECTOR PP-1578/PD.



CAUTION

Use the adapter ONLY when United Kingdom dosimeters are charged.

CHARGER, RADIAC DETECTOR PP-1578A/PD.



Operating Instructions for Charger PP1578/PD. Because of the differences between the PP1578/PD charger and the PP1578A/PD charger, the procedures for preparing and using each charger model are presented separately.

Pre-operational Procedure. Before the PP1578/PD charger can be operated, the following steps must be performed:

- Step 1. Remove the charger from the carrying case.
- Step 2. Pull the dust cap straight out of the charging socket.
- Step 3. Check to be sure that the charging socket is clean and dry.

CAUTION

The dust cap is not airtight or watertight. If water or moisture has collected, or if dust, dirt, or other foreign matter has entered the charging socket, the charging socket must be cleaned and dried thoroughly before use, or the charger will not operate properly.

- Step 4. Rotate the chuck counterclockwise to its fully operated position.
- Step 5. If the charger has not been used for a considerable time (a month or longer), turn the charging knob clockwise a minimum of 10 revolutions to activate the voltage regulator.
- Step 6. See that the charging end and the body of the dosimeter to be charged are thoroughly clean and dry.

Procedure for Installing the Adapter. If United Kingdom dosimeters are being charged, the adapter is installed by following the steps below.

- Step 1. Remove the adapter from the dust cap and make sure that the adapter is clean and dry.
- Step 2. Insert the adapter, larger end down, into the charging socket. Be sure that the adapter seats firmly in the charging socket.

CAUTION

Do NOT attempt to charge other types of dosimeter with the adapter installed.

The center post of the charger will collect static electricity which may affect the dosimeter. Operator should ground the center post against the side of the fitting, using any metal object, prior to charging a dosimeter.

Procedure for Charging a Dosimeter. Once the charger has been prepared it is used to charge dosimeters, as follows:

Step 1. Insert the charging end of the dosimeter into the charging socket as far as it will go; apply firm pressure straight downward.

CAUTION

Do NOT apply too much pressure on the dosimeter, or the plastic disk in the charging end of the dosimeter may rupture

Step 2. Hold the dosimeter firmly in the charging socket. Tighten the chuck by rotating it clockwise until the dosimeter is held securely in the charging socket.

Step 3. Hold the charger, with the dosimeter installed, so that the window is toward a good source of light. A good field expedient is a flashlight.

Step 4. Watch the calibrated scale of the dosimeter. Turn the charging knob clockwise until the dosimeter reading is zero (indicating fiber on 0). If the indicating fiber goes to the left of 0, rotate the charging knob back and forth or turn counterclockwise until a zero reading on the calibrated scale is obtained.

Step 5. Look into the viewing end of the dosimeter and observe the calibrated scale. If the indicating fiber can be seen, charge the dosimeter in the normal way. If the indicating fiber cannot be seen, proceed as follows:

a. Rotate the charging knob clockwise five full revolutions. Then observe whether the indicating fiber is visible. If the indicating fiber can be seen, charge the dosimeter in the normal way.

b. If the indicating fiber still cannot be seen, rotate the charging knob counterclockwise five full revolutions. Then observe whether the indicating fiber has appeared. If the indicating fiber can be seen, charge the dosimeter in the normal way.

c. If the indicating fiber cannot be seen, rotate the charging knob counterclockwise an additional five revolutions and again observe whether the indicating fiber has appeared. If the indicating fiber is visible, charge the dosimeter in the normal way. If the indicating fiber is not visible, the dosimeter or the charger is faulty.

Procedure for Checking Leakage. Install the dosimeter on the charger and watch the indicating fiber closely. The permissible leakage discharge rate is too slow to be seen on the dosimeter calibrated scale. If the indicating fiber can be seen to move upscale away from 0, either the dosimeter or the charger is dirty or faulty. Proceed as follows:

Step 1. Loosen the chuck, remove the dosimeter from the charging socket, and observe the reading on the dosimeter calibrated scale.

Step 2. If the indicating fiber can still be seen to move, clean the charging end of the dosimeter. Then repeat the charging procedure. If, after the second charging, leakage still is evident, the dosimeter is faulty.

Step 3. If leakage is evident when the dosimeter is installed in the charger but not when it is removed, clean the charging socket thoroughly. Then repeat the procedures for charging a dosimeter.

Step 4. If leakage still is evident when the dosimeter is in the charger but not when it is removed, the charger is faulty. However, the charger can still be used if it will charge a dosimeter below zero. If leakage is evident only when the dosimeter is in the charger, proceed as follows:

a. Install the dosimeter in the charger. Press down firmly on the dosimeter. Do not tighten the chuck.

b. Turn the charging knob clockwise until the indicating fiber is off the scale to the left of 0.

c. Watch the indicating fiber closely. Remove the dosimeter from the charger the instant the indicating fiber reaches 0 on the calibrated scale.

d. If necessary, repeat Steps a through c until a zero reading is obtained after the dosimeter is removed from the charger.

Procedure When a Capacitive Jump Occurs. On some dosimeters, particularly low range instruments, an instantaneous partial discharge may occur as the dosimeter is removed from the charger. This partial discharge is called a capacitive jump. After the dosimeter has been charged, loosen the chuck and remove the dosimeter from the charging socket. Then observe the reading on the calibrated scale. If the indicating fiber has jumped upscale, proceed as follows:

Step 1. Install the dosimeter in the charger. Turn the charging knob clockwise until the indicating fiber is on the downscale side of 0 an amount equal to the capacitive jump.

Step 2. Remove the dosimeter from the charger and observe the reading.

Step 3. Repeat Steps 1 and 2 until a zero reading is obtained after the dosimeter has been removed from the charger. A zero reading on the dosimeter must be obtained after the dosimeter has been charged and checked.

NOTE

After the PP1578/PD charger has been used to charge the dosimeters, the charger is put back into its case.

Operating Instructions for Charger PP1578A/PD

Pre-operational Procedure. Before the PP1578A/PD charger can be operated, it must be prepared according to the steps below:

- Step 1. Remove the charger from the carrying case.
- Step 2. Unscrew the dust cap and lift it off the charging pedestal.
- Step 3. See that the charging pedestal is clean and dry.
- Step 4. If the charger has not been used for a month or longer, turn the charging knob clockwise a minimum of 10 revolutions to activate the voltage regulator.
- Step 5. Place the charger on a flat, level surface, such as a bench or table. Face the window of the charger toward a good source of light.
- Step 6. See that the charging end and body of the dosimeter are thoroughly clean.

Procedure for Charging a Dosimeter. After the charger has been prepared, it is used to charge dosimeters according to the following steps:

- Step 1. Place the charging end of the dosimeter over the charging pedestal. Then press the dosimeter straight down onto the charging pedestal.

CAUTION

Be sure to press the dosimeter straight down. Do NOT apply too much pressure to the dosimeter, or the plastic disk in the charging end of the dosimeter may rupture.

- Step 2. Hold the charger, with the dosimeter installed, so that the window is toward a good source of light.
- Step 3. Watch the calibrated scale of the dosimeter. Turn the charging knob clockwise until the dosimeter reading is zero (indicating fiber on 0). If the indicating fiber goes to the left of 0, rotate the charging knob back and forth or turn it counterclockwise until a zero reading on the calibrated scale is obtained.
- Step 4. Look into the viewing end of the dosimeter and observe the calibrated scale. If the indicating fiber can be seen, charge the dosimeter in the normal way. If the indicating fiber cannot be seen, proceed as follows:
 - a. Rotate the charging knob clockwise five full revolutions. Then observe whether the indicating fiber is visible. If the indicating fiber can be seen, charge the dosimeter in the normal way.

b. If the indicating fiber still cannot be seen, rotate the charging knob counterclockwise five full revolutions. Then observe whether the indicating fiber has appeared. If the indicating fiber can be seen, charge the dosimeter in the normal way.

c. If the indicating fiber still cannot be seen, rotate the charging knob counterclockwise an additional five revolutions and again observe whether the indicating fiber has appeared. If the indicating fiber is visible, charge in the normal way. If the indicating fiber is not visible, the dosimeter or the charger is faulty.

Procedure for Checking Leakage. Install the dosimeter on the charger and watch the indicating fiber closely. The permissible leakage discharge rate is too slow to be seen on the dosimeter's calibrated scale. If the indicating fiber can be seen to move upscale away from 0, either the dosimeter or the charger is dirty or faulty. Proceed as follows:

Step 1. Remove the dosimeter from the charging pedestal and observe the reading on the dosimeter calibrated scale.

Step 2. If the indicating fiber can still be seen to move, clean the charging end of the dosimeter. Then repeat the charging procedure. If, after the second charging, leakage is still evident, the dosimeter is faulty.

Step 3. If leakage is evident when the dosimeter is installed in the charger but not when it is removed, clean the charging pedestal thoroughly. Then repeat the procedures for charging a dosimeter.

Step 4. If leakage still is evident when the dosimeter is in the charger but not when it is removed, the charger is faulty. However, the charger can still be used if it will charge a dosimeter below zero. If leakage is evident only when the dosimeter is in the charger, proceed as follows:

a. Install the dosimeter in the charger. Press down firmly on the dosimeter.

b. Turn the charging knob clockwise until the indicating fiber is off the scale to the left of 0.

c. Watch the indicating fiber closely. Remove the dosimeter from the charger the instant the indicating fiber reaches 0 on the calibrated scale.

d. If necessary, repeat steps a through c until a zero reading is obtained after the dosimeter is removed from the charger.

Procedure When a Capacitive Jump Occurs. On some dosimeters, particularly low range instruments, an instantaneous partial discharge may occur as the dosimeter is removed from the charger. This partial discharge is called a capacitive jump. After the dosimeter has been charged, remove the dosimeter from the charging socket. Then observe the reading on the calibrated scale. If the indicating fiber has jumped upscale, proceed as follows:

Step 1. Install the dosimeter in the charger. Turn the charging knob clockwise until the indicating fiber is on the downscale side of 0 an amount equal to the capacitive jump.

Step 2. Remove the dosimeter from the charger and observe the reading.

Step 3. Repeat Steps 1 and 2 until a zero reading is obtained after the dosimeter has been removed from the charger. A zero reading on the dosimeter must be obtained after the dosimeter has been charged and checked.

NOTE

After the PP1578A/PD charger has been used, it is replaced in its carrying case.

Dosimeter Reading. To prevent excessive leakage of charge, dosimeters must be recharged after no more than 2 or 3 days of use (preferably every day). They must also be recharged when the total dose reaches or exceeds 500 cGy(rad) on the scale. Recharging times are normally designated in the unit SOP.

Procedure for Leakage Testing. The charge that is placed on the dosimeter will gradually leak off even though the dosimeter is not exposed to X-rays or gamma rays. This leakage, if excessive, will cause an improper reading on the dosimeter during use. The leakage should not be more than 2 percent of full-scale reading per day for a good dosimeter. Check the leakage rate as discussed below and continued on the page following.

NOTE

If the dosimeter has not been charged for an extended period of time (or has been stored in an uncharged condition), and is then fully charged, excessive leakage may occur. This excessive leakage is due to insulation soak-in (penetration of part of the charge into the insulation). Do NOT perform a leakage-rate check on the dosimeter until it has been charged to 0 for 5 consecutive days. Ignore the daily leakage that may occur during this period.

Step 1. Charge the dosimeter to read 0 on the calibrated scale.

Step 2. Store the dosimeter in an area free of radiation for a 24-hour period.

Step 3. Note the reading on the calibrated scale of the dosimeter. This reading represents the leakage rate in cGy(rad).

NOTE

If the leakage rate reading for a period of one day is difficult to determine, the charged dosimeter may be allowed to set for several days until a readable value can be obtained. When the reading is obtained, divide the total reading by the number of days that the charged dosimeter was allowed to set to obtain the average daily leakage rate.

Step 4. If the leakage rate is greater than 12 cGy(rad) per day for the IM93/UD or IM9A/UD, or 1 cGy(rad) per day for the IM47/PD, clean the charging end of the dosimeter.

Step 5. Recheck the leakage rate following Steps 1 through 4. If the leakage rate is still greater than the values given in Step 4, the dosimeter is defective and should be replaced.

The acceptable leakage rate per day for each of the dosimeter models is as follows:

IM93/UD.....12 cGy(rad)

IM93A/UD.....12 cGy(rad)

IM47/PD.....1 cGy(rad)

Perform Operator Maintenance on Dosimeters and Chargers.

Maintenance of the dosimeter consists of the following:

Cleaning and decontamination.

Checking leakage rate.

Preventive maintenance checks and services.

Cleaning and Decontamination

The following equipment and materials are required for maintenance of the dosimeter:

RADIAC detector charger.

Detergent (commercial type).

Denatured alcohol.

Cleaning. To clean the socket in the charging end of the dosimeter, proceed as follows:

CAUTION

Do NOT insert sharp objects into the charging end of the dosimeter. Sharp objects will damage the interior of the socket and the charging contact.

Step 1. Remove the protective cap from the dosimeter.

Step 2. Carefully wash the open ends of the dosimeter with a few drops of denatured alcohol.

CAUTION

Do NOT blow on the dosimeter and do NOT use a drying cloth. The charging end of the dosimeter must be free of moisture and lint.

Step 3. Thoroughly dry the dosimeter by rapidly waving it in the air.

Step 4. Replace the protective cap on the dosimeter.

NOTE

If the protective cap is lost or defective, it must be replaced by clear cellophane tape or similar material.

Decontaminating. To decontaminate the dosimeter and charger, proceed as follows:

Step 1. Prepare a solution of detergent and clean water.

Step 2. Wash the dosimeter thoroughly with a cloth dampened in the solution.

Step 3. Rinse the dosimeter with a cloth dampened in clean water.

Step 4. Wash both ends of the dosimeter with denatured alcohol.

Leakage Test. Leakage testing will be in accordance with procedures outlined previously.

Routine Services. Routine services are tasks performed by the operator anytime they must be done. The tasks involve non-operational care of the equipment. Tasks such as cleaning off dirt, dust, and grease, or replacing a loose protective cap are examples of routine services. Routine services shall be done anytime they are required..

Preventive Maintenance Checks and Services (PMCS). The PMCS table is a checklist for the operator in evaluating the dosimeter and its readiness condition. Columns in the table identify the items requiring inspection and the interval. They provide a procedure and standard for checking, and a standard for determining whether the dosimeter is ready for its mission.

**OPERATOR PREVENTIVE
MAINTENANCE CHECKS AND
SERVICES (PMCS).**

ITEM NO.	ITEM TO BE INSPECTED	INTERVAL				PROCEDURES CHECK FOR AND HAVE REPAIRED OR ADJUSTED AS NECESSARY	FOR READINESS REPORTING EQUIPMENT IS NOT READY/ AVAILABLE IF:
		B	D	A	M		
1.	Excessive, standby leakage	X			X	NOTE Dosimeters should normally be held in a charged condition (standby) prior to use/mission. If dosimeters are not held in standby, perform leakage test prior to use. Read the dosimeter when removing it from standby and if reading is considerably higher than other dosimeter readings perform leakage test.	More than 10% of on hand dosimeters are unable to pass leakage test.
2.	Ability to charge	X			X	Charge dosimeter to 0.	Unable to charge more than 10% of on hand dosimeters to 0.
3.	Excessive leakage			X		NOTE For dosimeters held in standby, perform items 1 and 2 only and return to standby. Read dosimeters during use to record exposure. When large unexplained readings are recorded, perform leakage test to verify dosimeter operation.	
4.	Recharge for standby			X		After use, recharge dosimeter to 0 and place in standby.	

IM93()/UD and IM147/PD dosimeters will be inspected and calibrated by an ACRC or area support team possessing the AN/UDM/2 Calibration Set, RADIAC at 5-year intervals.

NOTE

Perform checks in the order listed: B-Before, D-During, A-After, and M-Monthly.

RADIAD Detector Chargers. Maintenance on the charger PP1578/PD consists of cleaning the charging socket and adapter. Maintenance of the charger PP1578A/PD consists of cleaning the charging pedestal and adapter. These items are cleaned with detergent and rinsed thoroughly with clean water. Use as little water as possible.

CAUTION

Do NOT use cleaning compound or other solvent type cleaners.

Air dry the equipment thoroughly. Do not wipe the adapter, the inside of the charging socket, or the outside of the charging pedestal with a cloth or other material that may leave lint or other residue on the charging surfaces. Such foreign matter would defeat the purpose of cleaning.

Clean the exterior of the charger with a clean, dry, lint-free cloth.

Field Testing. The chargers are field-tested using the following procedures:

Step 1. Rotate the charging knob clockwise five full revolutions.

Step 2. Install a dosimeter in the charging socket of the PP1578/PD, or on the charging pedestal of the PP1578A/PD.

Step 3. Charge the dosimeter. A zero reading on the dosimeter calibrated scale should be obtained with no less than one-fourth revolution nor more than five revolutions of the charging knob.

Step 4. Check the performance of the charger and the dosimeter.

NOTE

To keep the maximum number of usable chargers in the field, users will retain those faulty chargers that can charge a dosimeter below zero.

USE AND MAINTAIN IM174 SERIES RADIACMETER

CONDITIONS

Nuclear burst activity has been reported in your area of operations. You are given an IM174 Series Radiacmeter. The appropriate operator's technical manual (TM) or extract for the IM174 series radiacmeter used is available for preventive maintenance checks and services (PMCS) only. You are also given appropriate battery or batteries; clean, lint-free cloth; a soft brush; a stiff brush; fine sandpaper (No. 000); a flat-tip screwdriver (or similar object); a general cleaning solution (if needed). If a cleaning solvent such as trichlorotrifluoroethane, is used, you should be in a well-ventilated area. Do not breathe the vapors. You are to monitor your unit's area for possible radiological contamination.

STANDARDS

The following procedures are performed in accordance with (IAW) the TM appropriate for the IM174 model used:

1. The appropriate battery or batteries are installed.
2. PMCS are performed.

a. All deficiencies/shortcomings correctable at operator level are identified and corrected.

b. All deficiencies/shortcomings not corrected are reported to the supervisor.

NOTE: Uncorrected deficiencies/shortcomings must be recorded on DA Form 2404 IAW DA Pam 738-750. However, this is not a performance measure of this task.

3. The IM174 Radiacmeter is prepared for use.
4. The designated area is monitored for the presence of radiological contamination.
5. The dose rate reading is determined and reported to supervisor.
6. The IM174 Radiacmeter is shut down after use.

PERFORMANCE MEASURE

1. Installs battery or batteries
 - a. Opens battery compartment and inspects the inside for signs of water leakage, loose terminals, corrosion, and dirt.
 - b. Cleans battery compartment, if needed.

c. Checks the battery or batteries for signs of leakage and corrosion. Replaces, if necessary.

d. If the IM174 is equipped with a light, checks the battery/lamp compartment. Replaces lamp, if necessary, IAW TM 11-6665-232-12, paragraph 4-9.

2. Performs PMCS.

a. Checks instrument for cleanliness.

b. Inspects instrument for cracked or broken meter glass.

c. Checks to see that the mechanical action of each knob and switch is smooth and free of external or internal binding and that no looseness is apparent. Checks panel for sticking or bent pointer.

3. Prepares the radiacmeter for use.

a. Zeroes the instrument.

b. Performs battery check.

4. Monitors designated area.

NOTE: At this point the evaluator will set a reading on the radiacmeter.

5. Determines dose rate reading and reports to evaluator.

NOTE: This reading must be within ± 10 percent.

6. Performs shutdown procedures.

7. Completes the task within 30 minutes.

REFERENCES

FM 21-3, Task 031-503-3003

USE AND MAINTAIN IM174-SERIES RADIACMETER

In order to operate and maintain the IM174 Series Radiacmeter, you must learn the use of the IM174 Series Radiacmeter, the procedures for installing batteries and placing the equipment into operation, and performing operator's maintenance.

Use of the IM174 Series Radiacmeter

The IM174 Series Radiacmeter is a portable, tactical monitoring and survey instrument designed to measure the dose rate of gamma radiation. It is

normally issued on the basis of one per platoon-size unit. Once nuclear operations have started, company/battery/troop units use the IM174 Series Radiacmeter to monitor for radiation. When monitoring reports do not provide sufficient information for evaluation of contaminated areas, a radiological survey may be directed. The IM174 Series Radiacmeter is the instrument used to perform radiological surveys which determine the extent and dose rates of radiation in the area.

Install Batteries in the IM174 Series Radiacmeter

In order for you to install batteries in the IM174 Series Radiacmeter, you must be familiar with each model and type of radiacmeter and the type of battery required for each.

IM174B/PD Single-battery Type Radiacmeter. The IM174B/PD single-battery type radiacmeter uses one BA 30/U battery. The following procedure is used to install the BA 30/U battery.

Step 1. Unsnap the snap fasteners and remove the radiacmeter from the carrying case.

Step 2. Set the zero control to OFF.

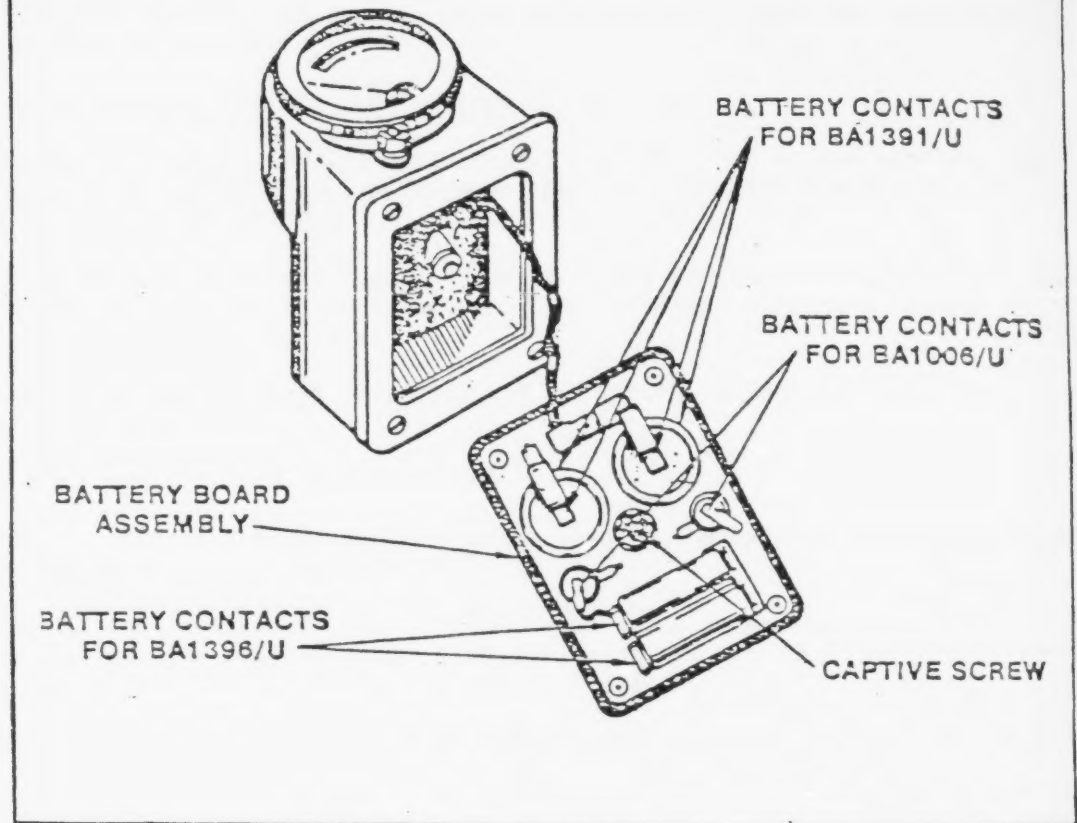
Step 3. Unscrew the two captive screws holding the battery compartment cover, and remove it.

Step 4. Insert a BA 30/U (or BA 3030/U for a low temperature operation) battery into the battery compartment following the instructions on the label to insure that the battery polarity is correct.

Step 5. Replace the battery compartment cover. Tighten the two captive screws firmly.

Step 6. Replace the radiacmeter in its carrying case, and secure the snap fasteners.

BATTERY BOARD ASSEMBLY AND LOCATION OF BATTERY CONTACTS.



Step 6. Using the same procedure given in Step 5, install two BA 1391/U batteries. Carefully insert the two BA 1391/U batteries in their contacts so that the + (plus) polarity marking on each battery coincide with the + polarity marking on the battery board assembly.

Step 7. Carefully position the BA 1396/U batteries on board assembly, ensuring the (+-) polarity markings coincide.

Step 8. Carefully position the battery cover, which contains the battery board assembly. Check the cable which is attached to the battery board assembly to be sure it is at the rear of the radiacmeter.

Step 9. Secure the battery cover, which contains the battery board assembly, to the radiacmeter by tightening the captive screw.

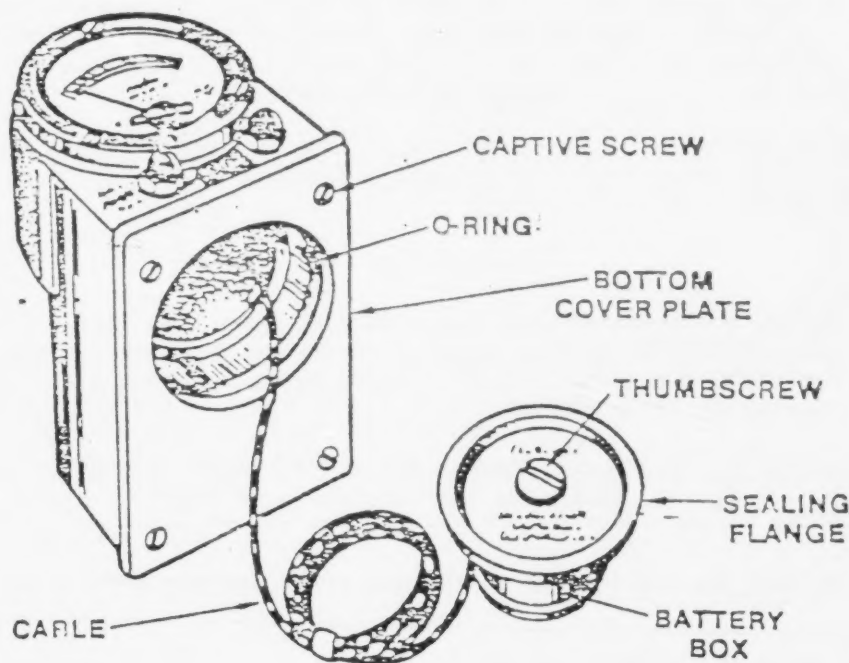
Step 10. Replace the radiacmeter in its carrying case and secure the snap fasteners.

IM174/PD Radiacmeter. The IM174/PD Radiacmeter uses three batteries. Two are BA 1318/U batteries and one is a BA 1288/U battery. The following procedure is used to install the batteries.

Step 1. Unsnap the snap fasteners and remove the radiacmeter from the carrying case.

Step 2. Loosen the thumbscrew (turn it counterclockwise) on the battery box, and remove the battery box from the recess in the bottom cover plate of the radiacmeter. Do not place any excess strain on the cable.

IM-174/PD WITH BATTERY BOX .
REMOVED.



Step 3. Press down the lock plate, turn it to the left, and lift off the battery box.

Step 4. Lift the phenolic retaining plate from the battery box.

Step 5. Examine the battery cavities and clean them, if necessary.

Step 6. Install battery BA 1288/U in its cavity in the battery box so that the + (plus) sign faces the center (threaded shaft).

Step 7. Install each battery BA 1318/U in its respective cavity in the battery box; observe the polarity markings on the bottom of the battery box and on each battery.

Step 8. Replace the phenolic retaining plate on the battery box by orienting the phenolic retaining plate with the battery box so that the locating pin on the battery box mates with the locating hole on the phenolic retaining plate.

Step 9. Replace the lock plate by orienting it with the battery box so that the locating holes and locking holes on the lock plate mate with the locating pins and the lock plate screws on the battery box. Press down on the lock plate, and turn it to the right until it is secure under the lock plate screws.

CAUTION

If the battery box is to be replaced in the radiacmeter without batteries (for shipment or storage), secure the lock plate to the battery box. This will prevent the lock plate and the phenolic retaining plate from slipping off the lock plate screws and becoming damaged.

Step 10. Wrap the cable around the battery box. Be sure that the cable is wrapped snugly and flush against the sealing flange (no more than one layer of cable) of the battery box.

CAUTION

Do NOT allow the wrapped cable to slip down into the smaller portion of the recess. The cable might be cut and thereby prevent the radiacmeter from operating when the thumbscrew is tightened.

Step 11. Carefully replace the battery box in the recess of the bottom cover plate of the radiacmeter. Make sure that the cable is still in place, and then hand tighten the thumbscrew. Do NOT overtighten the thumbscrew.

Step 12. Replace the radiacmeter in the carrying case and secure the snap fasteners.

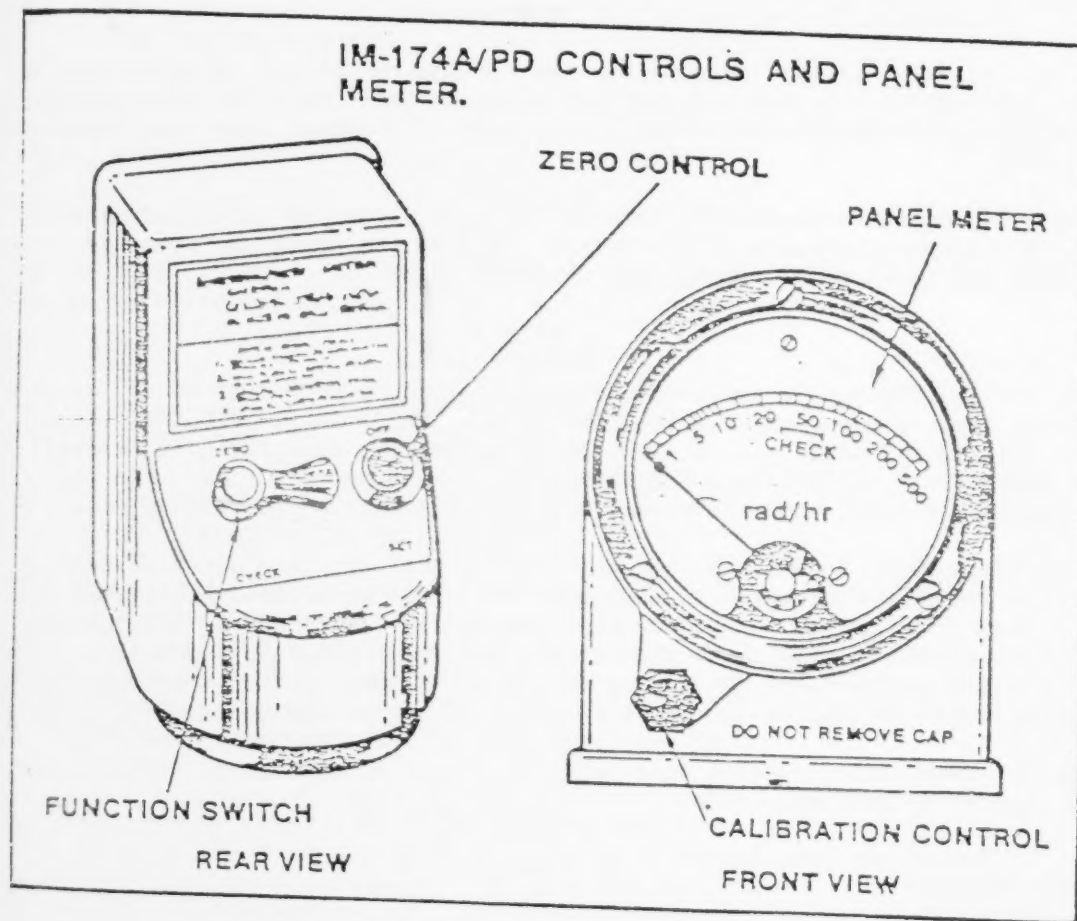
Operate the IM174 Series Radiacmeter.

To operate the IM174 Series Radiacmeter, you must know the function of the controls. You must also be able to zero the radiacmeter and check the condition of the batteries.

IM174A/PD Controls and Panel Meter. Besides the panel meter, the IM174A/PD has a zero control, function switch, calibration control, and lamp switch. The function of each control is described as follows:

Zero Control

- When placed at OFF, turns the radiacmeter off.
- When placed at SET, turns the radiacmeter on and adjusts the meter to zero.



- Function switch is spring-loaded.
- When held at ZERO, permits the meter to be adjusted to zero in or out of radiation field.
- When held at CHECK, permits the circuits and batteries to be checked.
- When ready to operate center position (normal operating position), permits intensity dose rates to be measured on the 0-500 cGy(rad)/hr scale of the meter.

Step 6. Release the function switch. The pointer of the meter should return to 0.

Step 7. Unsnap the carrying case snap fastener at the rear of the carrying case. Pull the top part of the carrying case over the top of the radiacmeter, and fasten the snap fasteners on the sides and front of the carrying case.

NOTE

During operation of the radiacmeter, the radiacmeter should be positioned so that the meter face is up and parallel to the ground. Hold the meter waist high and make a 360° turn (circle), recording the highest dose rate reading observed.

Step 8. Measure the radiation dose by taking the reading indicated on the 0 - 500 cGy(rad)/hr scale of the meter. Observe the radiation readings through the front clear face of the carrying case.

NOTE

When the radiacmeter is operated continuously over a period of hours, or when extreme temperature changes are experienced, a small drift or change in the zero reading may occur. To correct this action, the operator must readjust the appropriate control (steps 3 through 6). Measurements taken with the radiacmeter are not accurate unless the zero control is properly adjusted.

Some radiacmeters do NOT have an instrument light, but have a luminescent radioactive dial that permits reading of the meter under low light level conditions. Others do not have a radioactive dial, but have an instrument light that permits reading of the meter under low light level conditions. To operate the instrument light, press and hold the lamp switch; the lamp should light. When the lamp switch is released, the lamp should go out.

Step 9. When radiation dose rate readings have been completed, turn off the radiacmeter as follows:

- a. Unsnap the snap fasteners on the front and sides of the carrying case.
- b. Push back the top part of the carrying case.
- c. Turn the zero control counterclockwise to OFF.
- d. Pull the top of the carrying case over the top of the radiacmeter, and fasten the snap fasteners on the sides and front of the carrying case.

CAUTION

When the equipment is not in use, remove the batteries. If the radiacmeter is equipped with an instrument light, the battery you remove from the instrument light battery compartment should be identified. This battery should not be used for any other purpose, and should be returned to its respective location when the batteries are reinstalled in the equipment.

Operation of the IM174A/PD Under Unusual Conditions. The radiacmeter can operate under unusual conditions, such as extreme heat, cold, humidity, and altitude, without special precautionary measures.

At low temperatures, the batteries used to power the radiacmeter have a shorter life than at room temperature. At -50°F , a continuous working life of approximately 9 hours can be expected. For a longer period, replace batteries with fresh batteries.

CAUTION

When the equipment has been exposed to temperatures below 0°F , allow the equipment to warm up to 0°F ; (in a shelter, if necessary) before opening for service or battery change. Failure to observe this caution may result in cracking of the insulation on the battery cable.

If readings must be taken under the adverse conditions described above, a spare set of batteries should be available. These batteries may be stored inside the operator's clothing so that the operator's body will supply the heat necessary to keep the batteries at a desirable operating temperature. The batteries may be exchanged with the cold batteries. The cold batteries will recover after warm-up, and may be reused.

If you plan to operate a single-battery type IM174B/PD radiacmeter in temperatures below 10°F , a BA 3030/U battery should be installed.

IM174/PD Controls and Panel Meter. Besides the panel meter, the IM174/PD has a set control, a function switch, and a CALIB Control. The function of each is described below.

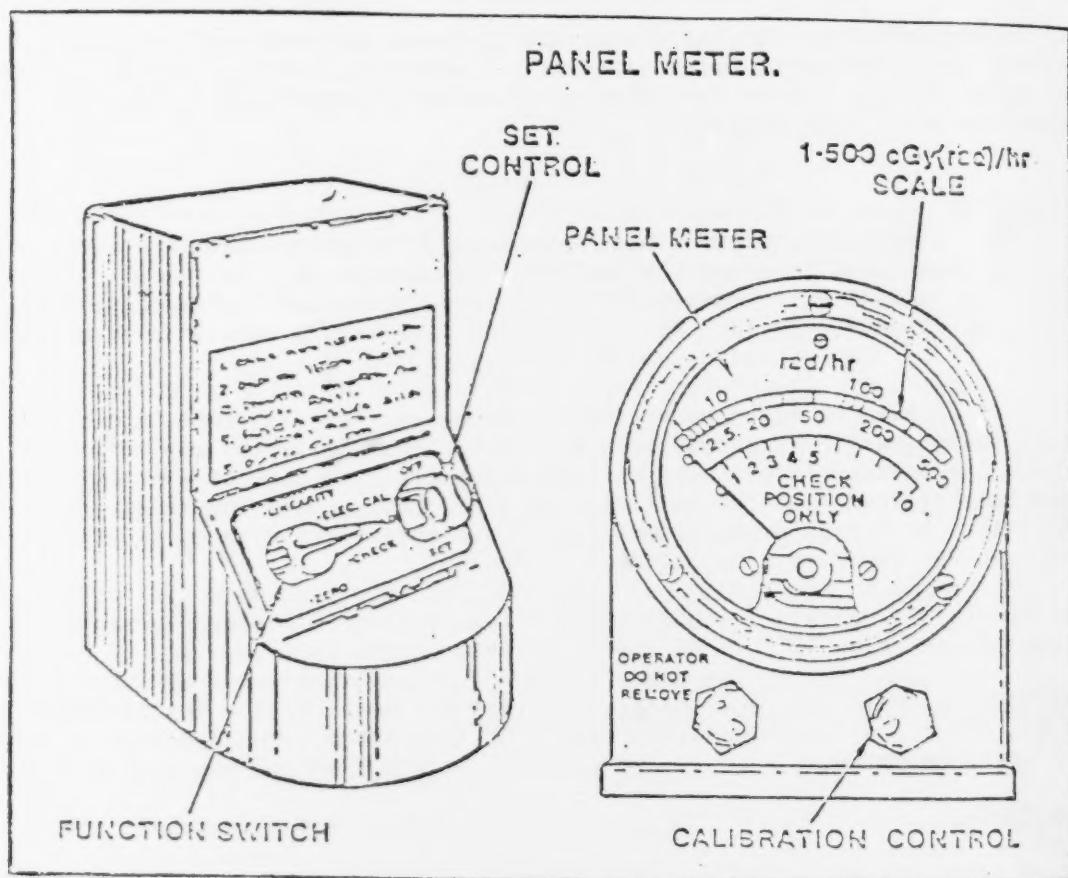
Set Control.

- ° When placed in OFF position, turns radiacmeter off.
- ° When turned clockwise (past click), turns radiacmeter ON and adjusts meter to zero (with function switch held at ZERO).

Function Switch. The function switch has five positions:

- ° Zero. Spring-loaded position, sets up radiacmeter to permit adjusting (with set control) panel meter to zero in radiation field.

- ° Check. Sets up radiacmeter to check operation of the ionization chamber. May be used for rough measurement (survey) of low intensity radiation dose rate on 0.1 to 10 cGy(rad)/hr scale (CHECK position only) of panel meter.
- ° Read. Sets up radiacmeter for normal operation. Radiation dose rates measured on 0 to 500 cGy(rad)/hr scale of panel meter.
- ° Elec Cal. Sets up radiacmeter to simulate 500 cGy(rad)/hr radiation dose rate to permit adjusting (with CALIB Control) panel meter to 500 cGy(rad)/hr.



- ° Linearity. Spring-loaded position; sets up radiacmeter to simulate 50 cGy(rad)/hr radiation dose rate for checking linearity of panel meter at medium intensity dose rates. Also checks performance of batteries.

CALIB Control

- ° Potentiometer-type control protected by cap; permits operator to adjust panel member to 500 cGy(rad)/hr when function switch is set to ELEC CAL.

CAUTION

The calibration control on the left side of the front panel (marked OPERATOR DO NOT REMOVE) is used by higher category maintenance personnel only during radiacmeter calibration with a radioactive source. Under no circumstances should the operator or organizational maintenance personnel remove the cap of this calibration control.

Panel Meter

- ° Indicates radiation dose rate from 0 - 500 cGy(rad)/hr on the 0 - 500 scale with function switch at READ.

Operations of the IM174/PD Under Usual Conditions. Simplified operating instructions are provided on the OPERATING INSTRUCTIONS plate on the rear of the radiacmeter. Detailed operating instructions are provided below and continue on the following page.

NOTE

During the starting procedure and the operating procedure, the radiacmeter should be zero-adjusted and operated while the meter is in the same plane. For example, if the meter is horizontal with respect to the ground during zero-adjustment, the meter should be kept in a horizontal position during the remainder of the starting and operating procedures. If the plane of the meter is changed, the meter should again be zero-adjusted; otherwise, incorrect readings may be obtained.

To start the radiacmeter after any shutdown, the following procedures must be performed:

- Step 1. Unsnap the snap fasteners on the front and sides of the carrying case.
- Step 2. Push back the top part of the carrying case, and secure it to the carrying case snap fasteners near the rear of the radiacmeter.
- Step 3. Turn on the radiacmeter by turning the set control clockwise (just past the click) from OFF. Allow at least 2 minutes for the radiacmeter to warm up.

NOTE

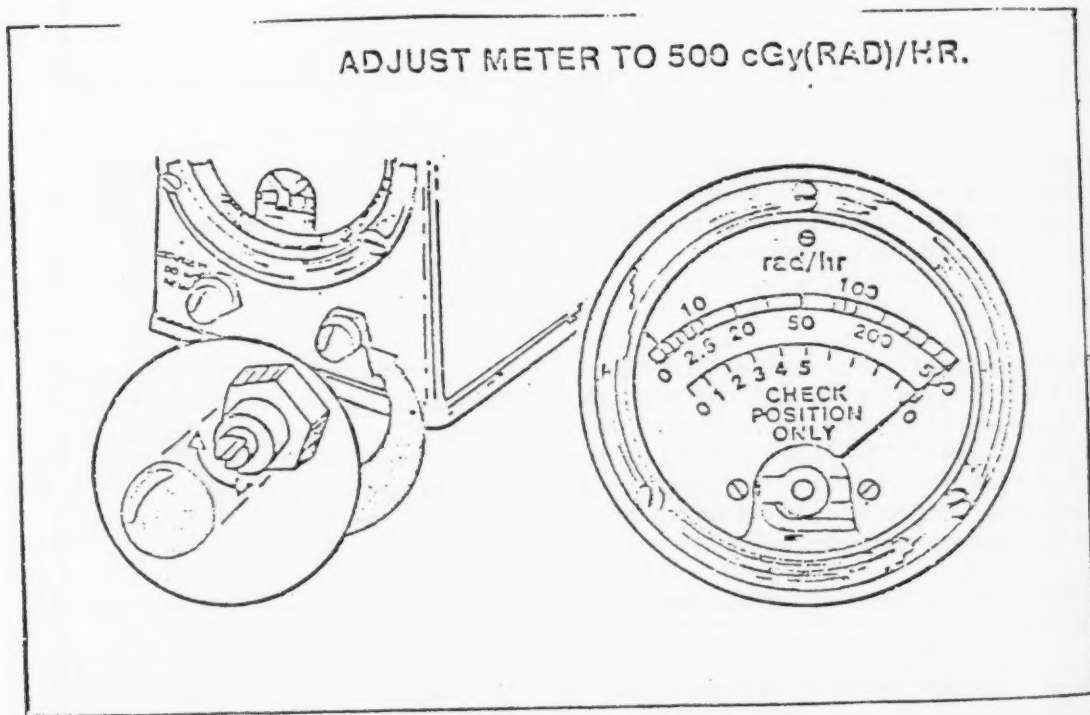
If time permits, allow 20 minutes for complete warm-up.

Step 4. Hold the function switch at ZERO, and adjust the SET control until the pointer on the panel meter indicates 0.

Step 5. Release the function switch to the CHECK position. The panel meter pointer should give a sudden kick up-scale and then drop back to 0.

Step 6. Set the function switch to ELEC CAL. The panel meter pointer should indicate 500 cGy(rad)/hr.

If the pointer does not indicate 500 cGy(rad)/hr, remove the cap from the CALIB control (on the right-hand side of the front panel) and adjust the control until the panel meter pointer indicates 500 cGy(rad)/hr. Replace the cap on the CALIB control.



NOTE

This procedure provides an indication that the radiacmeter is probably calibrated. If a panel meter indication of 500 cGy(rad)/hr cannot be obtained by adjusting the CALIB control, change the batteries and repeat the procedures given in Steps 3 through 6. If a panel meter indication of 500 cGy(rad)/hr still cannot be obtained by adjusting the CALIB control, the radiacmeter is defective and should be turned in for higher category maintenance.

Step 7. Hold the function switch in the LINEARITY position. The panel meter pointer would fall within the red mark on the face of the meter.

NOTE

If the pointer indicates outside the red mark, change the batteries and repeat the procedures given in steps 3 through 7.

CAUTION

Continuous operation over a period of hours or extreme temperature changes may cause a small drift or change in the ZERO adjustment or in the ELEC CAL calibration. To correct this action, readjust the SET control (step 4) and the CAL control (Step 6).

To operate the radiacmeter after starting it, you perform the following steps:

Step 1. Set the function switch to READ. The radiation dose rate will be indicated on the 0 to 500 cGy(rad)/hr scale of the panel meter.

Step 2. When the radiation dose rate measurements have been completed, shut down the radiacmeter.

To stop the operation of the radiacmeter and put it away, you do the following:

Step 1. Turn the SET control to OFF.

Step 2. Unsnap the carrying case snap fasteners at the rear of the radiacmeter.

Step 3. Pull the top of the carrying case over the top of the radiacmeter, and fasten it to the snap fasteners on the front and sides of the carrying case.

NOTE

If the radiacmeter is not to be kept in use, remove the batteries.

Operation of the IM174/PD Under Unusual Conditions.

The radiacmeter can operate under unusual conditions, such as extreme heat, cold, humidity, and altitude, without special precautionary measures. At temperatures below +35°F, however, the batteries that supply power to the radiacmeter have reduced efficiency which may result in unsatisfactory equipment performance. To avoid this condition, proceed as follows:

Step 1. Loosen the thumbscrew and remove the battery box from the radiacmeter bottom plate cover.

Step 2. Stretch out the cable connecting the battery box to the radiacmeter.

Step 3. Place the battery box under the operator's clothing so that the body heat will keep the batteries at a desirable operating temperature.

Monitoring Techniques Using the IM174 Radiacmeter

There are two techniques for monitoring dose rate with the IM174 Radiacmeter. They are the direct technique and the indirect technique.

Direct Technique. The direct determination of ground dose rate is the simplest and most precise of the monitoring techniques. The unshielded ground (outside) dose rate may be determined directly by standing at the desired location, holding the IM174 radiacmeter waist high in a vertical position (face up), turning with the radiacmeter in a 360° turn (circle), and recording the highest dose rate reading observed. The preferred procedure is to take readings in the open at least 10 meters away from buildings, other large structures, or objects that may shield out a portion of the radiation.

Indirect Technique. Monitoring Inside Shelters. Within the contaminated area, monitoring will normally be performed from within shelters or fortifications. The monitoring reading is obtained by noting the highest dose rate measured by the radiacmeter when it is held in the center of the shelter, one meter above the floor (waist high) and turning in a 360° circle.

Perform Operator Maintenance on the IM174 Series Radiacmeter

To perform operator maintenance on the IM174 Series Radiacmeter, you must be able to do the required operator preventive maintenance checks and services.

Operator's Preventive Maintenance

Operator's preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, reduce downtime, and assure that the equipment is serviceable.

Systematic care. Systematic care is essential to the proper upkeep and operation of equipment. The cleaning operations should be performed once a day. However, if the equipment is not used daily, cleaning should be performed before operation, after any extended shutdown, or once a week while equipment is kept in standby condition.

Preventive Maintenance Checks and Services. Preventive maintenance checks and services are made to determine serviceability, that is, to determine that the equipment is in good general (physical) condition, in good operating condition, and likely to remain serviceable.

NOTE

For frequency of calibration and maintenance calibration-check, refer to TB 43-180.

Scope of Operator Maintenance

The maintenance duties assigned to the operator of the IM174 Series Radiacmeter are given below. These duties do not require tools or test equipment. Operator maintenance duties are -

- ° Cleaning the radiacmeter
- ° Performing daily preventive checks and services
- ° Performing monthly preventive maintenance checks and services
- ° Troubleshooting
- ° Replacing the batteries and lamp

NOTE

The radiacmeter (except for the instrument light) is of sealed construction and does not permit the entry of dirt, dust, or moisture. Disassembly of the radiacmeter (other than for removal of batteries and cleaning of the battery compartment) should not be attempted by the operator; a higher category of maintenance or repair is required.

NOTE

The IM174LA/PD radiacmeter, in limited storage, does not require periodic preventive maintenance. However, before the radiacmeter is placed into operation, the operator must perform the required daily preventive maintenance checks and services.

Cleaning. Materials required for cleaning the radiacmeter include:

- ° Trichlorotrifluoroethane, Cleaning Compound, Freon-PGA
- ° Cleaning cloth
- ° Soft brush
- ° Stiff Brush
- ° Fine sandpaper (No. 000)

Procedures for cleaning the radiacmeter are as follows:

Step 1. Inspect the exterior of the radiacmeter. The exterior surfaces should be free from dust, dirt, grease, and fungus. Dust and loose dirt may be removed with a clean, soft cloth.

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a doctor immediately.

Step 2. Remove grass, fungus, and ground-in dirt from the case; use a cloth dampened (not wet) with the cleaning compound.

Step 3. Remove grease, fungus, and ground-in dirt from the carrying case and the sling assembly; use a stiff brush to remove excess dirt, and apply a cloth dampened (not wet) with trichlorotrifluoroethane.

CAUTION

Do NOT press on the meter face (glass) when cleaning; the meter may be damaged.

Step 4. Clean the front panel, the meter, and the control knobs; use a soft, clean cloth. If difficulty in removing dirt occurs, dampen the cloth in water. Mild soap may be used to make the cleaning more effective.

Step 5. Inspect the battery compartment (and the lamp battery compartment if the radiacmeter contains an instrument light). The compartment should be free of dirt, rust, corrosion, and fungus.

- ° Remove rust and corrosion from the battery contacts with fine sandpaper.

- ° Remove dust and loose dirt from the compartment with a soft brush.

- ° Remove fungus and ground-in dirt from the battery compartment with a cloth dampened (not wet) with trichlorotrifluoroethane.

Daily Preventive Maintenance Checks and Services

Preventive maintenance checks and services of the IM174 Series Radiacmeter assist operators in determining and maintaining serviceability of the equipment.

The following charts specify checks and services that must be accomplished daily under the following conditions:

- ° Before operation, and after any extended shutdown
- ° Once a week while the equipment is kept in a standby (ready for immediate use) condition

° When the equipment is initially installed (received)

The following charts indicate what to inspect, how to inspect, and what the normal conditions are. If a defect cannot be remedied by the operator, a higher category of maintenance or repair is required. Note any deficiencies which cannot be corrected on DA Form 2404, and turn the radiacmeter into organizational maintenance.

Operator's daily preventive maintenance checks and services chart for the IM-174A/PD radiacmeter.

Sequence Number	Item to be Inspected	Procedures
1	IM-174A/PD	Clean equipment.
2	Meter glass	Inspect for cracked or broken meter glass.
3	Controls and indicators	While making operational check (item 4), observe that mechanical action of each knob and switch is smooth and free of external or internal binding. Also, check meter for sticking or bent pointer. NOTE Knobs that require frequent tightening should have setscrews replaced.
4	Operation	Check operation of equipment.

Operator's daily preventive maintenance checks and services chart for the IM-174/PD radiacmeter.

Sequence Number	Item to be Inspected	Procedures
1	IM-174/PD	Clean equipment.
2	Meter glass	Inspect for cracked or broken meter glass.
3	Controls and indicator.	While making operating checks, (sequences 4 through 12), check to see that mechanical action of each control is smooth and free of external or internal binding and that no looseness is apparent. Also, check panel meter for sticking or bent pointer. NOTE Knobs that require frequent tightening should have set-screws replaced. OPERATING CHECKS
4	Carrying case	Release snap fasteners on front and sides of carrying case. Push back top of carrying case, and secure it to snap fasteners at rear of radiacmeter.
5	SET control	Rotate SET control clockwise from OFF; panel meter pointer moves toward high end of scale. (If time permits, allow 20 minute warmup.)
6	Function switch and SET control	Hold function switch at ZERO, and adjust SET control until panel meter pointer indicates 0.

(continued). Operator's daily preventive maintenance checks and services chart for the IM-174/PD radiacmeter.

Sequence Number	Item to be Inspected	Procedures
7	Function switch	Release function switch to CHECK; panel meter pointer kicks up-scale and then drops back to 0.
8	Function switch and CALIB control	Set function switch to ELEC CAL and adjust CALIB control until panel meter pointer indicates 500 cGy(rad)/hr.
9	Function switch	Hold function switch at LINEARITY; panel meter pointer should indicate within red mark (50 cGy(rad)(hr + 5).
10	Function switch	Release function switch to READ; panel meter pointer should indicate 0 (if no radiation is present).
11	SET control	Rotate SET control to OFF.
12	Carrying case	Unsnap fasteners, pull top of carrying case over top of radiacmeter, and secure snap fasteners.

USE AND MAINTAIN AN/PDR 27 RADIAC SET

CONDITIONS

You are given a complete AN/PDR27 RADIAC Set. The appropriate operator's technical manual (TM) or extract for the AN/PDR27 model used is available for preventive maintenance checks and services (PMCS) only. You are also given a bucket of water; soft, clean, lint-free cloths; appropriate batteries; and a screwdriver. Personnel, equipment, and supplies that are suspected to be radiologically contaminated are present.

STANDARDS

The following is performed in accordance with the TM appropriate for the AN/PDR 27 model used.

1. PMCS are performed.
 - a. All deficiencies/shortcomings correctable at operator level are identified and corrected.
 - b. All deficiencies/shortcomings not corrected are reported to the supervisor.

NOTE

Uncorrected deficiencies/shortcomings must be recorded on DA Form 2404 in accordance with (IAW) DA Pam 738-750. However, this is not a performance measure of this task.

2. The AN/PDR 27 RADIAC Set is prepared for use.
3. Personnel, equipment, and supplies are monitored so that the probe does NOT touch items being monitored.
4. The presence of radiological contamination is determined.
5. The type (beta, gamma, or beta/gamma) of radiation present is identified.
6. The dose rate reading for gamma is determined and reported to supervisor.

PERFORMANCE MEASURES

1. Performs PMCS.
2. Prepares the RADIAC Set for use.
3. Monitors personnel, equipment, and supplies.
4. Does not touch the probe to the object being monitored.

5. Determine if radiological contamination is present.
6. Identifies the type of radiation, if present.
7. Determines the dose rate reading.
8. Completes the task within 30 minutes.

REFERENCES

FM 21-3, Task 031-505-3009

USE AND MAINTAIN AN/PDR27 RADIAC SET

The AN/PDR 27 RADIAC Set is a portable, battery-operated radiation detector and indicator designed to detect beta and measure gamma radiation.

It contains a low-range dose-rate Geiger-Mueller (G-M) type instrument used for monitoring personnel, food, and equipment. It is issued on the basis of one per divisional company-size combat, combat support, combat service support unit, and as required for medical, maintenance and bath units, and water supply points.

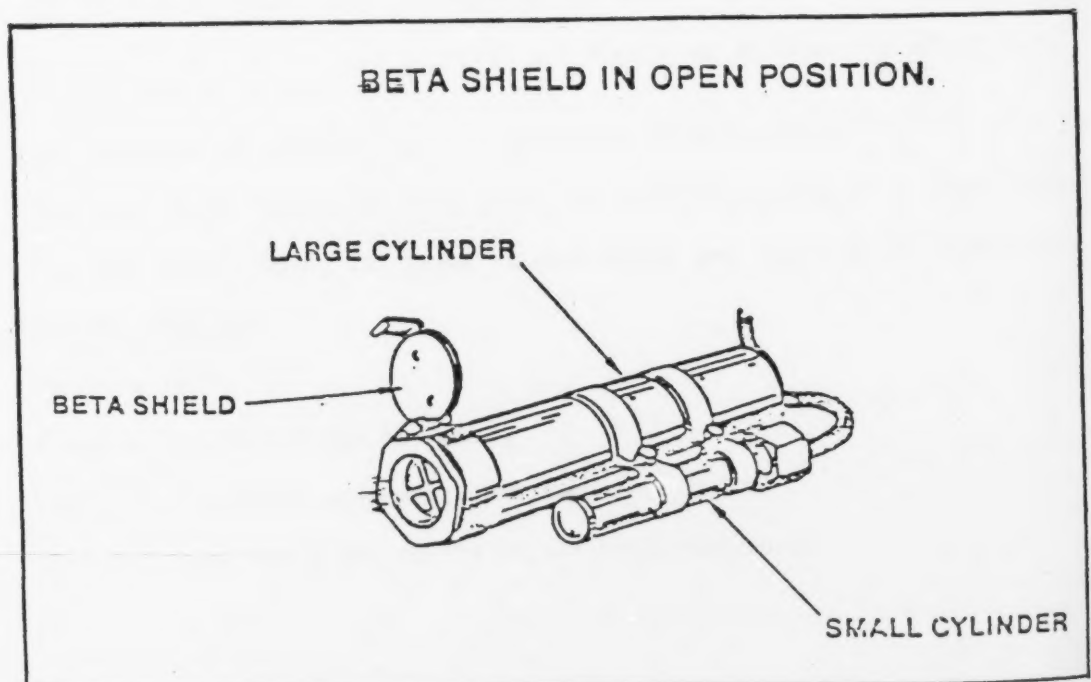
Capabilities

The AN/PDR 27 RADIAC LSet is a low-range dose-rate instrument which detects and measures up to 500 millirads per hour of gamma radiation and can detect the presence of beta radiation.

Four ranges of sensitivity are provided within the operating capabilities of the AN/PLDR 27 RADIAC Set. The four sensitivity ranges are: 0.5, 5, 50, and 500 millirad per hour.

The two higher (less sensitive) ranges use a G-M tube which is contained in the smaller cylinder of the probe. Only high-intensity gamma radiation can be measured on these two ranges.

The larger cylinder of the probe contains a different G-M tube, which can detect low-intensity gamma radiation. This tube is used on the two lower (more sensitive) ranges. When the removable beta shield is moved away from the window on the end of the probe, beta-plus-gamma radiation can be detected.



Characteristics

When you are issued an AN/PDR27 RADIAC Set it will consist of the following:

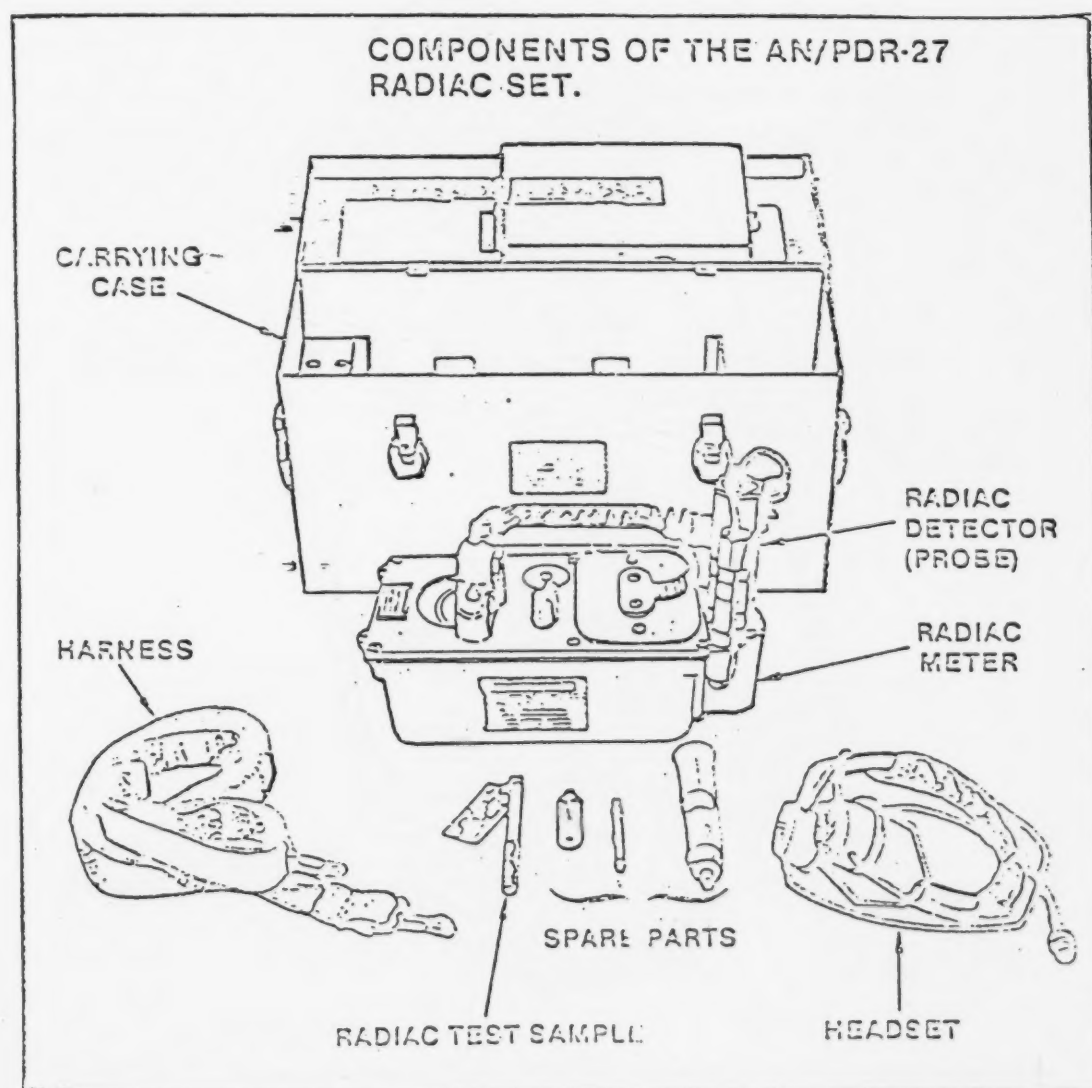
Radiacmeter

RADIAC Detector (Probe)

Headset

Radioactive test sample

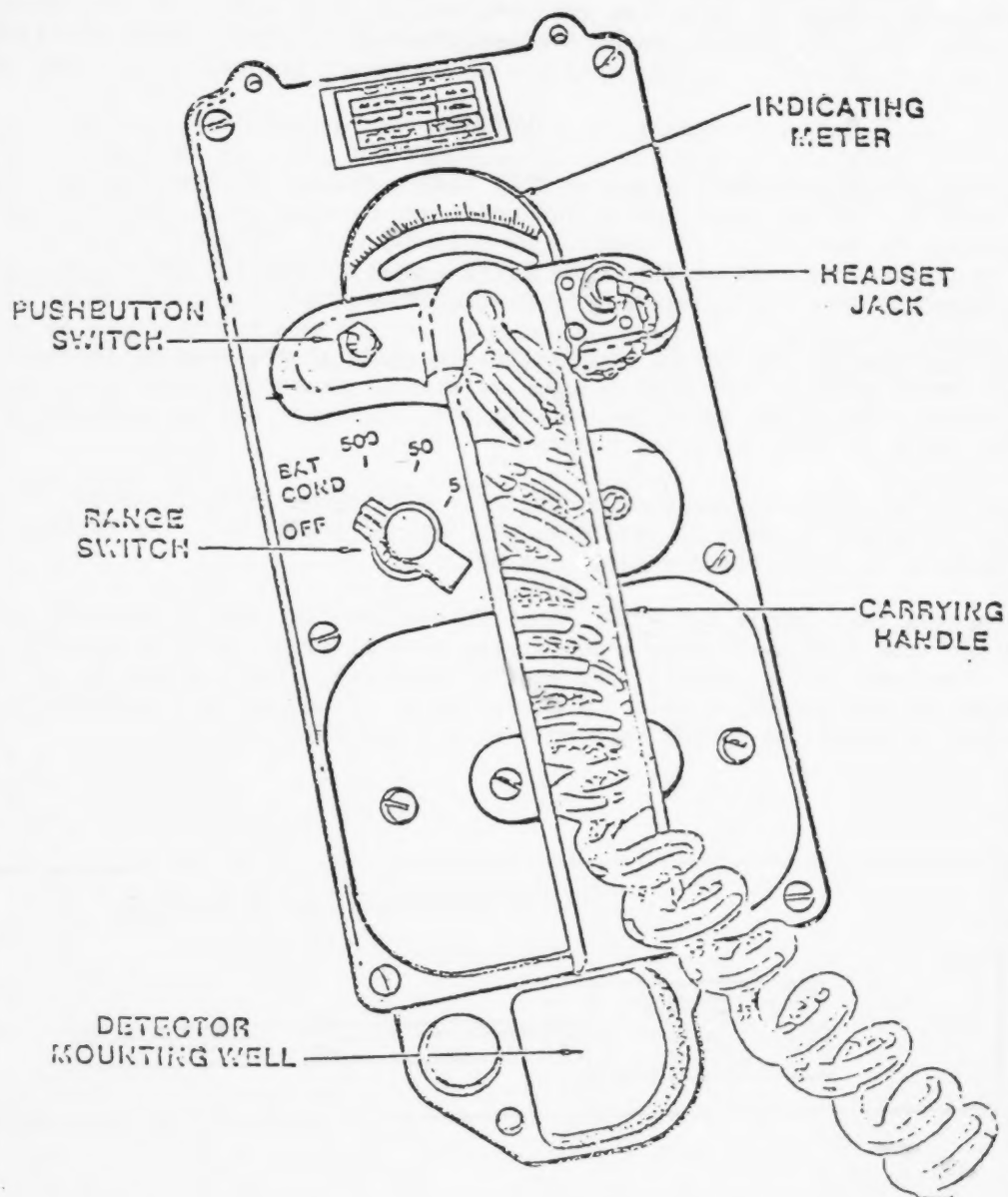
Harness



Radiacmeter. The radiacmeter includes a housing made of two aluminum castings. The top casting, or panel, supports all of the electronic circuitry and includes a separate sealed battery compartment. The bottom casting acts as a cover which encloses the electronic circuitry and the battery compartment. The radiacmeter is powered by six BA 30 batteries.

Mounted on the panel is an indicating meter, a range switch, a push-button switch, and headset jack. The carrying handle provides space for stowing the detector cable when the detector is placed into its mounting well.

RADIACMETER PANEL.



The indicating meter is placed behind a sealed glass window for waterproofing. It has five movable scales which are mechanically coupled to the range switch so that the scale corresponding to the switch position is presented.

RADIAC Detector. The RADIAC detector is a probe consisting of a type JAN-5979 Geiger-Mueller tube and a type JAN-5980 Geiger-Mueller tube, each enclosed in its own cylindrical metal housing. The two housings are clamped together into one unit. A movable metal shield normally covers the mica window of the larger tube. When the shield is over the window, beta radiation is excluded from the tube. The shield can be swung aside when beta-plus-gamma radiation readings are desired.

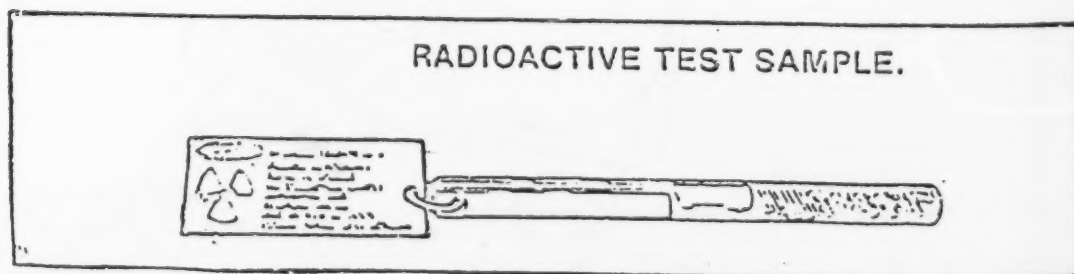
CAUTION

Since the mica window is only 0.0005 inches thick, it is extremely fragile. Do not touch the window under any circumstances, as damage to the tube will result. Do not rely upon the guard ring to protect the mica window. The guard ring openings are large enough so that sharp objects may pierce the window.

Electrical connections for both G-M tubes are made at the ends of the housings where the shielded cables pass through waterproof packing glands to the tube electrodes. The probe cable is flexible and kink-proof and is normally coiled in the space in the top of the handle.

Headset. The headset provides the operator with sound indications of radiation intensity when plugged into the jack on the panel. The headset is designed to be worn inside a battle helmet.

Radioactive Test Sample MLX 7338. The radioactive test sample consists of an aluminum tube holding a capsule containing five millicuries of Krypton 85 gas. The tube is flattened at one end for handling. The Krypton 85, as shielded by its holder, provides a gamma radiation source that permits the operator to check the operating condition of the RADIAC set.



WARNING

Krypton 85 is a gas which is radioactive, emitting beta and gamma radiation. In this test sample, the shielding permits only the gamma radiation to escape. Krypton is chemically inert. If the test sample is damaged so that the capsule leaks, remove the sample to the open or to a well-ventilated area. Flush the air from the spaces or rooms where the test sample has been stored. If the sample is examined with a RADIAC Set AN/PDR 27 or other equally sensitive set and is found to be free of radioactivity, the gas has escaped and the aluminum rod is harmless.

Harness. The shoulder harness, an adjustable strap made of nonabsorbent plastic, is used for carrying the radiacmeter during operation. Clip fasteners on each end of the strap snap into holes in small projections on the radiacmeter panel.

Carrying Case. The carrying case houses all the other units of the RADIAC Set. It is splash-proof and is equipped with a welded-on carrying handle. The case is aluminum and can readily be decontaminated. Compartments to carry a spare set of batteries as well as all the other components are provided in the case.

PREPARE THE AN/PDR27 RADIAC SET FOR USE

In order to prepare the AN/PDR 27 RADIAC Set for use, you must be able to install the batteries and to check the operation of the radiacmeter with and without the use of the radioactive test sample.

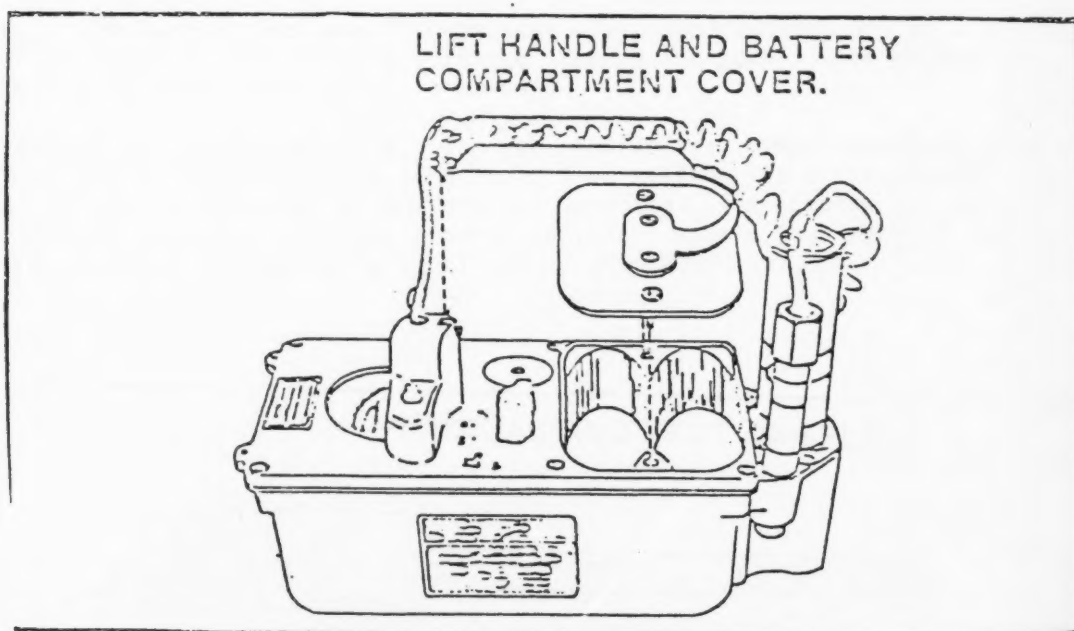
Battery Installation

Batteries must be installed in the RADIAC Set before the set can be operated. In addition, one set of spare batteries should be placed into the carrying case. These batteries are to be used as field spares. When installing batteries, perform the following steps:

Step 1. Use BA 30, BA 3030 or commercial D size.

Step 2. Place spare batteries in the spare battery compartment of the carrying case.

Step 3. Remove the radiacmeter from the carrying case. Fully loosen the one captive screw securing the front of the handle to the turret of the panel. They loosen the two outer screws securing the cover of the battery compartment to the panel. Lift the handle which removes the cover and the battery holder top.



Step 4. Insert the batteries in the battery compartment, observing the polarities indicated on the insulator at the bottom of the compartment.

PREPARE THE AN/PDR27 RADIAC SET FOR USE

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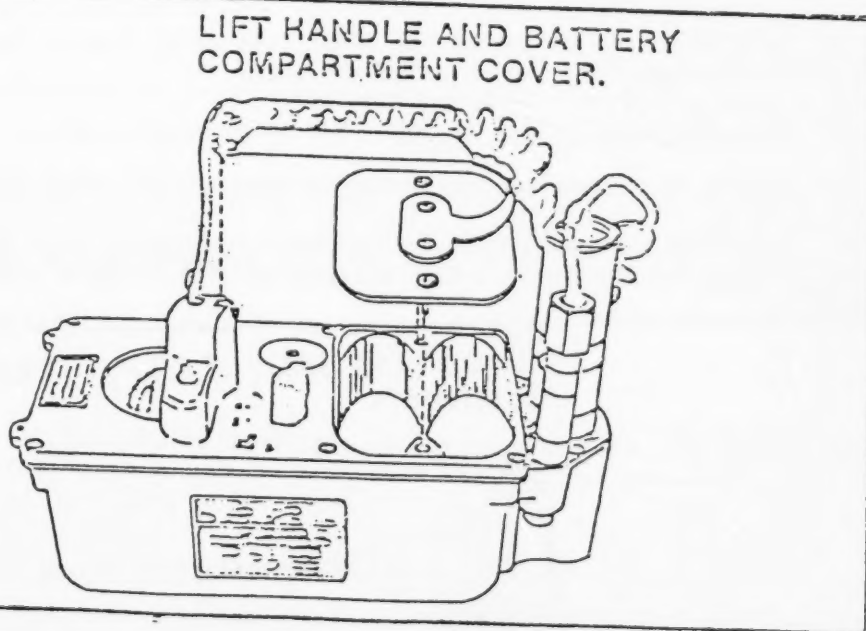
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Batteries must be installed in the RADIAC Set before the set can be operated. In addition, one set of spare batteries should be placed into the carrying case. These batteries are to be used as field spares. When installing batteries, perform the following steps:

Step 1. Use BA 30, BA 3030 or commercial D size.

Step 2. Place spare batteries in the spare battery compartment of the carrying case.

Step 3. Remove the radiacmeter from the carrying case. Fully loosen the one captive screw securing the front of the handle to the turret of the panel. Then loosen the two outer screws securing the cover of the battery compartment to the panel. Lift the handle which removes the cover and the battery holder top.



Step 4. Insert the batteries in the battery compartment, observing the polarities indicated on the insulator at the bottom of the compartment.

Step 5. Replace the battery-holder top and cover, observing that the rubber bumpers are lined up with the spaces at the center, and tighten the two cover-attaching screws. Screws must be tightened equally, or the rubber gasket may be damaged. Tighten the screw at the front end of the handle.

CAUTION

Do not use excessive force in tightening screws. Breakage may result.

Pre-operational Checks

To check the RADIAC Set before placing it in operation, the procedure to follow depends on whether or not a radioactive test sample is available.

Check, Using Radioactive Test Sample. If a radioactive test sample is available, follow the procedures listed below.

WARNING

Steps 4 through 9 involve handling the radioactive test sample. Hold the sample by the flattened end. Perform the work as rapidly as possible to avoid unnecessary exposure. Replace the sample promptly in the carrying case.

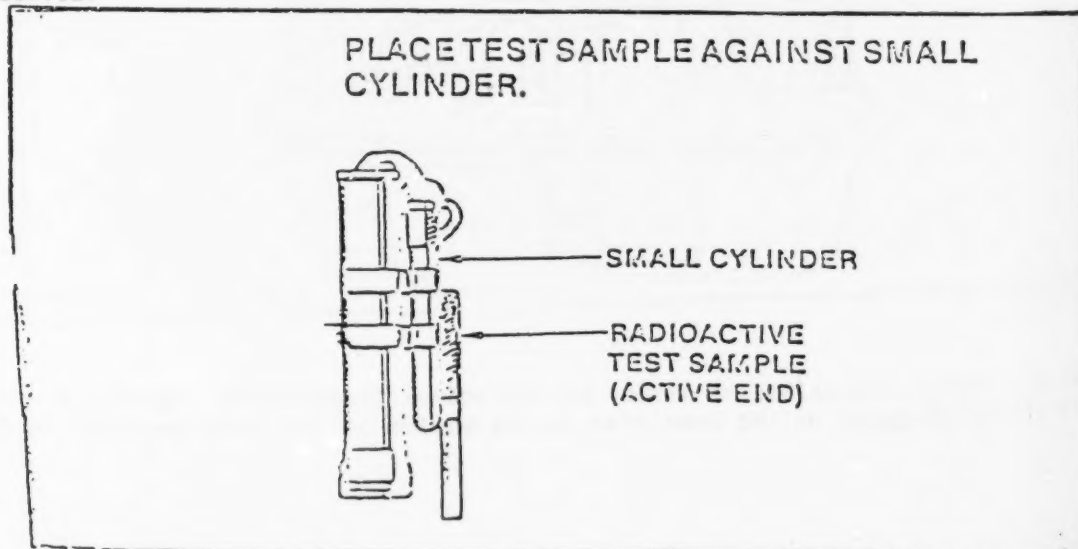
Step 1. Remove the radiacmeter from the carrying case.

Step 2. Turn the range switch to BAT COND. The meter should read to the right of the halfway mark indicator on the meter.

Step 3. Turn the range switch to 500. The meter reading should be zero.

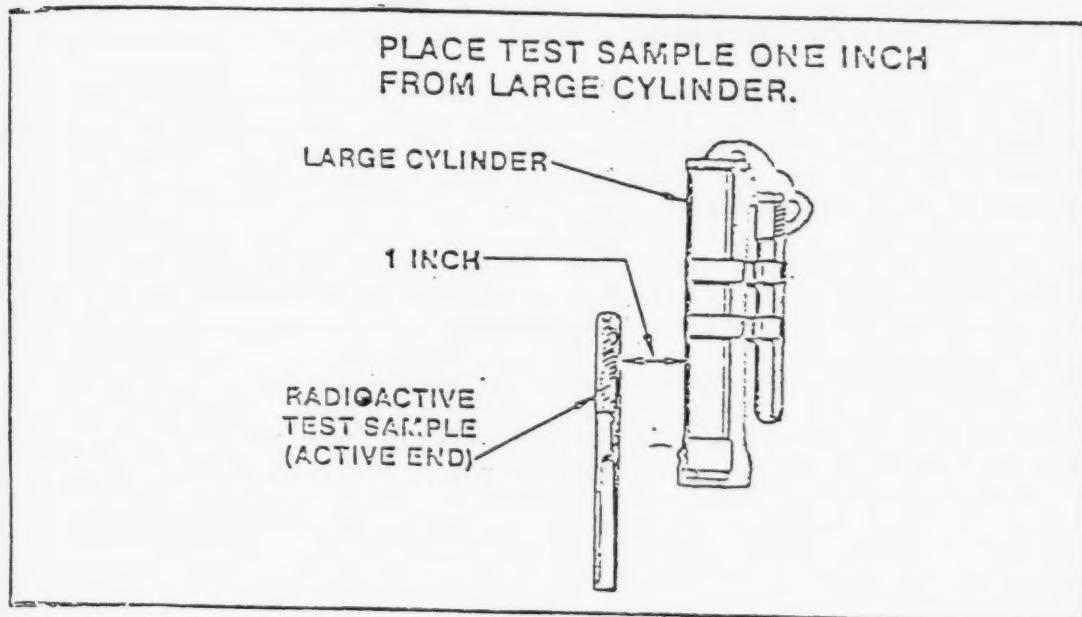
Step 4. Remove the radioactive test sample from the carrying case.

Step 5. Place the active (purple) end of the test sample flat against the smaller cylinder of the probe. A meter reading within scale limits should be observed.



Step 6. Turn the range switch to 50. Place the active end of the test sample as in Step 5. A meter reading within the scale limits should be observed.

Step 7. Turn the range switch to 5. Place the active end of the test sample about one inch from the larger cylinder of the probe. A meter reading within the scale limits should be observed.



Step 8. Turn the range switch to 0.5. Place the active end of the test sample about 6 inches from the larger cylinder of the probe. A meter reading within the scale limits should be observed. Placing the sample close to the probe should make the meter indicate at the top of the scale.

Step 9: Replace the test sample in the carrying case.

Step 10. Turn the range switch to OFF.

When the meter readings within the scale limits are observed, the RADIAC Set is in proper operating condition. If the pointer does not move, the radiacmeter should be turned in for repair.

NOTE

Since the half-life of Krypton 85 is approximately 10 years, the readings produced by the sample will gradually decline to half their previous value each 10-year period. The sample is usable as long as it will produce the minimum readings.

Check Without Radioactive Test Sample. If the test sample is not available, follow the procedures discussed below.

This test depends on using natural background radiation. A radiation source other than the Radioactive Test Sample may be used if available.

Step 1. Turn the range switch to 0.5. Connect the headset. Listen for clicks. Observe the meter closely. The meter pointer will swing irregularly at the low end of the scale whenever a click or a group of clicks is heard.

Step 2. Turn the range switch to 5.0. The meter pointer swing will be greatly reduced from Step 1, but the clicks in the headset will continue at the same rate. If the pointer swings and clicks are heard at irregular intervals, then the two low-range positions are in operation, including the G-M tube in the large cylinder.

Step 3. To test the upper range, turn the switch to the 50 position. Listen carefully for clicks. The clicks will be as slow as one per minute or one per 2 minutes. Generally, there will be no movement of the pointer.

Step 4. If a radium-dial watch or other radioactive source is available, place it close to the probe and try all switch positions. To obtain the largest possible reading, turn to the 0.5 position, open the beta shield on the probe, and hold the source at the open end. There should be a swing of the meter pointer and clicks in the headset.

Preparation for Use

To start the AN/PDR 27 RADIAC Set, perform the following steps:

Step 1. Remove the radiacmeter harness and headset from the carrying case.

Step 2. Attach clips on the harness through the carrying holes in each end of the radiacmeter panel.

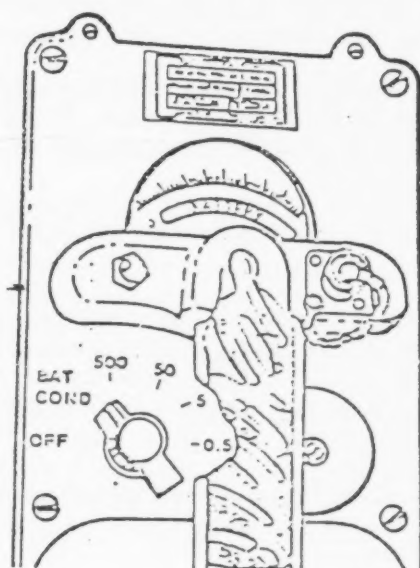
Step 3. Place one arm through the opening, slip the harness over the head, and arrange the assembly so that the radiacmeter is on the left side of the body and the strap is over the right shoulder.

Step 4. Lengthen or shorten the adjustable shoulder strap of the harness for a comfortable fit.

Step 5. When sound indications are desired, put on the headset and connect its plug to the jack on the radiacmeter panel.

Step 6. Turn the range switch to BAT COND and observe the meter indication. If the pointer rests at the right of the center line in the area marked BATTERY on the movable dial, the batteries are in operating condition. If the pointer is to the left of the center line, the batteries are exhausted. Replace all batteries in the radiacmeter.

CHECK CONDITION OF BATTERIES.



Operating Procedures

After preparing the AN/PDR 27 Radiac Set for use as previously instructed, perform the following steps:

Step 1. Open the beta shield. Listen for clicks in the headset or observe the meter reading while approaching the radioactive object or area. In a weak radiation field, it is necessary to use the headset, because the clicks can be heard clearly, even when the movement of the meter pointer is very small.

Step 2. Determine the background reading before taking any readings. Do this by turning away from the contaminated subject. At 180° , the body of the person will shield the instrument from the contamination. This will give a more accurate reading than if the person turned a complete circle. When making the reading, the electronic saturation causes the needle to fluctuate slightly. The person taking the reading will make a visual average from the lowest to the highest reading. Usually there will not be a big difference.

NOTE

Contamination is any reading that is twice the reading of background radiation obtained in a contamination free environment.

Step 3. Turn the range switch to a lower (more sensitive) range whenever the meter reading is less than five divisions; turn it to a higher (less sensitive) range if the meter pointer approaches the high end of the scale.

Step 4. When using the headset for searching for a radioactive object, start with the range switch at 0.5. If the clicks increase to a steady noise, turn to a higher scale.

Step 5. When it is desired to locate a radioactive object or the center of a radioactive area, move the radiacmeter in the direction that produces an increase in the meter reading or in the frequency of the clicks in the headset. Continue moving in this direction until the point of maximum radiation intensity is found.

Step 6. If the object or area to be investigated is relatively inaccessible, remove the radiac detector from its mounting well and pass the detector probe back and forth over the area.

Step 7. When the radiation from an object or area is extremely weak, bring the detector probe within a few inches of the object to obtain the largest possible indication on the meter or the loudest sound in the headset. A closer approach is necessary because radiation intensity decreases rapidly with distance.

Step 8. To determine the type of radiation, perform the following steps:

- a. Turn the range switch to 0.5.
- b. Remove the RADIAC detector from its mounting well. Swing open the beta shield on the end of the large cylinder of the probe.
- c. Point the exposed end of the probe at the object, and slowly move it until a readable meter indication is obtained. Remember this reading.
- d. Close the beta shield over the end of the probe. Monitor the same object again. Compare this reading to the earlier reading.

e. If you had a reading with the beta shield open, but no reading when the shield was closed over the end of the probe, beta radiation is present.

f. If you had a higher reading when the beta shield was open than when the shield was closed, both beta and gamma radiation are present.

b. If you had the same or lower reading when the beta shield was closed, only gamma radiation is present.

Step 9. If the equipment has been used continuously for more than 1000 hours, check the condition of the batteries in the radiacmeter by turning the range switch to BAT COND. When the meter pointer rests to the left of the center line--not in the area marked BATTERY -- replace all batteries.

Step 10. Stop the equipment by turning the range selector switch to OFF. Remove the harness and headset from the radiacmeter, place the RADIAC detector probe into its mounting well, and stow all items in the carrying case.

Emergency Operating Procedures

If one of the major components of the radiacmeter is replaced, the radiacmeter will probably be out of calibration. Even though the radiacmeter may be inaccurate with respect to absolute intensity, it will still be usable to indicate relative intensity within any one scale position.

This means that it is possible to recognize in which of two locations the intensity is higher, even though the actual intensities are in error. If readings are taken in the two locations on the same scale position, the higher reading correctly represents the higher intensity.

PERSONNEL, EQUIPMENT, SUPPLIES, AND WATER

Personnel, equipment, food³, and water are likely to be radiologically contaminated and should be monitored following a nuclear attack or the completion of fallout in a unit area. The purpose of monitoring is to determine decontamination requirements and also to determine if supplies of food and water must be destroyed. Acceptable or safe levels of remaining radioactive contamination should be established by the commander on recommendations of the medical officer. In the absence of specific guidelines, a dose-rate reading as close to background (the environmental reading) as practical will be considered acceptable.

Monitoring of Personnel

When operational areas are contaminated, personnel monitoring stations should be established as soon as practicable at the lowest unit level having the AN/PDR 27 RADIAC Set. All personnel leaving the contaminated areas should be monitored. Personnel who are contaminated will be required to decontaminate themselves, except those physically disabled. Personnel monitoring is performed to detect contamination on the body. Proper monitoring of personnel

consists of complete and careful checking of those parts of the body and clothing most susceptible to contamination.

The procedures for personnel monitoring are as follows:

Step 1. Turn the range switch to 500.

Step 2. The soldier should stand straight with feet spread apart about 30 centimeters (1 foot). Arms should be extended to the side with palms up and fingers straight.

Step 3. The probe must be held perpendicular to the surface being monitored.

Step 4. The end of the probe should have the beta shield open and should be held 2 to 3 centimeters (about 1 inch) from the soldier's hand. Monitor both hands. If little or no radiation is detected, go to the scale where there is a reading. If no reading is shown on the 0.5 scale, continue to use that scale.

Step 5. Do not contaminate the probe by touching it to the surface being monitored. Move the probe along the surface with a slow steady motion.

Step 6. Move the probe over both hands and arms to the shoulders. Have the soldier turn palms down. Move the probe over the back of both hands and arms.

Step 7. Move the probe over the front of the body. Start at the head. Check hair, forehead, nose, lips, neck, body, knees, and ankles.

Step 8. Going from head to foot, monitor the back of the soldier.

Step 9. Have the soldier raise each foot; check soles.

Step 10. If no radiation was detected, tell the soldier. If radiation is detected, have the soldier decontaminate. Tell your supervisor of the contamination that was found.

Monitoring of Equipment

Equipment that has been exposed to radiation or that has been in a contaminated area must be monitored. This should be performed at a material monitoring station as near the contaminated area as possible. Equipment that is found to be contaminated should remain within a restricted area until the contamination either is removed or has decayed to background level. In general, care should be taken when monitoring equipment to pay particular attention to those surfaces where the contamination is most likely to occur, such as the wheels, tires, and undersides of vehicles and aircraft; and greasy surfaces, floors, and steps. Before an attempt is made to recover or evacuate contaminated equipment, a check should be made to determine the practicability of this action. If the contamination is such that it exceeds the capabilities of any unit to decontaminate the equipment to permit recovery and evacuation,

the location should be noted. This information should be forwarded to the next higher headquarters so that advice and assistance on decontamination or disposal may be obtained.

The probe window of the radiacmeter should be held about 2 to 3 centimeters (1 inch) from the surface being monitored for beta-gamma contamination. The range switch should be at the 500 scale. The probe should be moved along the surface with a slow, steady motion and held perpendicular to the surface being monitored. If little or no radiation is shown, go to the next lower scale. If no radiation is shown on the 0.5 scale, continue to use that scale. Tell your supervisor when you find radioactive contamination.

Monitoring of Food

Except in rare cases of induced radiation, rations in cans or other sealed containers are not in danger of radiological contamination. As the contamination will normally be limited to the outer surface of the sealed containers, decontamination is accomplished by removing the contamination from the outer-surface. This may be done by removing the outer packaging or by washing or scrubbing the containers under running water. Under no condition should sealed containers be opened until they have been decontaminated and the effectiveness of decontamination established.

Food not protected in sealed containers must be suspected of contamination until monitored. All food should be removed from the contaminated area to a clean area. Potatoes and hard-skinned fruits and vegetables can be decontaminated by washing or scrubbing them under running water, followed by the peeling or scraping and washing again. Running water, if a creek or stream, should be checked for contamination, especially since the water source may be in a GZ or fallout area. All visible dirt should be brushed from meats and fish; washing is not recommended. Meat or fish should be monitored with the probe open and held approximately 1 centimeter (about 1/2 inch) from the surface of the food. If the reading exceeds background, then the food should be decontaminated if possible. A thin layer of meat can be removed and the food remonitored. A reduction in dose rate would indicate that the contamination was confined to the surface of the food. The cutting away process can be continued, within practical limits, until the dose-rate reading is acceptable. If the dose rate is within acceptable limits initially or after the outer layer or layers have been removed, the food can be safely consumed. As prepared food in open containers will probably be contaminated, it should be disposed of by burial or as otherwise determined by designated medical personnel. Radiologically contaminated wash water and trimmings should be similarly disposed of.

Any food that has been exposed to radiological contamination must be carefully monitored before and after decontamination. Foods in which radioactivity has been induced can only be decontaminated by aging. Careful monitoring will determine the progress of radioactive decay during aging.

Monitoring of Water

Water that has been in a contaminated area or is suspected of being contaminated should be monitored and declared safe before it is used for drinking by personnel.

Decontamination of water is an engineer responsibility. Determination of the potability and approval of water is a responsibility of the surgeon for Army units.

Radioactive contaminants in water are not affected by boiling or by other water-treatment methods designed for chemical or biological decontamination.

PERFORM OPERATOR MAINTENANCE ON THE AN/PDR 27 RADIAC SET

In order to perform operator maintenance on the AN/PDR 27 RADIAC Set, you must be able to do the required operator preventive maintenance checks and services.

Operator Preventive Maintenance

Operator preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, reduce downtime, and ensure that the equipment is serviceable.

Systematic Care. Systematic care is essential to the proper upkeep and operation of equipment. The cleaning procedures should be performed once a day. If the equipment is not used daily, the cleaning procedure must be performed before operation, after any extended shutdown, or once a week while the equipment is kept in standby condition.

Preventive Maintenance Checks and Services. Preventive maintenance checks and services are made to determine combat serviceability; that is, to determine that the equipment is in good general (physical) condition, in good operating condition, and likely to remain combat serviceable.

Scope of Operator Maintenance

Maintenance service and inspection of the AN/PDR 27 RADIAC Set is required daily. In addition to the routine daily services and inspection, the equipment should be reinspected and serviced immediately before going on a mission and as soon after completion of the mission as possible. The maintenance duties assigned to the operator of the RADIAC set are listed below. The duties do not require tools or test equipment other than those issued with the set. Operator maintenance duties are:

Cleaning the RADIAC set.

Performing daily preventive maintenance checks and services.

Performing repairs and replacing parts.

Cleaning the RADIAC Set. Materials required for cleaning the RADIAC Set are:

Cleaning cloth.

Cleaning compound (National Stock No. 7930-00-395-0542)

Procedures for Cleaning the RADIAC Set. Procedures for cleaning the RADIAC Set are discussed below.

Radiacmeter and Carrying Case. Clean the exposed exterior surfaces of the radiacmeter and the carrying case as follows:

Step 1. Remove dust; moisture, and loose dirt with a clean, dry cloth.

WARNING

Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation; do not use near a flame.

Step 2. Remove fungus and ground-in dirt with a cloth dampened (not wet) with cleaning compound; dry thoroughly.

CAUTION

Do not press on the meter face; the meter may become damaged.

Step 3. Clean the meter face with a soft, clean cloth. If the dirt is difficult to remove, dampen (do not wet) the cloth with water; if necessary, use mild soap.

Battery Compartment. Remove all traces of dirt, grease, or corrosion from the batteries, battery compartment, and contacts with a clean cloth dampened (not wet) with cleaning compound; dry thoroughly.

Daily Preventive Maintenance Checks and Services

The daily maintenance service and inspection chart outlines inspections to be made each day. These inspections are made to determine combat serviceability. To assist the operators in determining and maintaining combat serviceability, the chart indicates what to inspect, how to inspect, and what the normal conditions are. If the defect cannot be remedied by the operator, higher echelon maintenance or repair is required. The operator should note any deficiencies which cannot be corrected on DA Form 2404 and turn it in to organizational maintenance.

**OPERATOR'S DAILY PREVENTIVE
MAINTENANCE CHECKS AND
SERVICES CHART FOR THE AN/PDR-
27 RADIAC SET.**

SEQUENCE NO.	ITEM TO BE INSPECTED	PROCEDURE
1	Completeness	See that equipment is complete.
2	Meter glass	Inspect for cracked or broken meter glass.
3	Cleanliness	Exterior surfaces must be clean and dry; free of grease, dirt, rust, corrosion, and fungus.
4	Controls	While making operating checks (item 6), observe that mechanical action of each control is smooth, and free of binding and that no looseness is apparent. Also check panel meter for sticking or bent pointer.
5	Test sample	Inspect the test sample for deformations, cracks, or splits that may cause leakage. If sample is damaged, discard it.  Hold the sample only long enough to make the inspection to avoid unnecessary exposure.
6	Operation	Perform the procedures given in Lesson 4/Learning Event 2 for checking the radiac set using the radioactive test sample.

Performing Repairs and Replacing Parts

Performing repairs and replacing parts (when necessary) are discussed in the following paragraphs.

Repairs. No repairs (other than battery replacement) of the RADIAC set are authorized the operator.

NOTE: Test sample must be turned-in IAW local policy as prescribed by local Radiation Protection Officer, usually the Division Chemical Officer.

Parts Replacement. Only the batteries are replaceable by the operator. To check battery condition, turn the range switch to BAT COND. The pointer on the meter should read to the right of the center line, in the area marked battery, on the meter scale. If the meter reading is low, the batteries are weak and should be replaced. If the batteries are 18 months old or older, they should be replaced regardless of their test reading. Battery cells usually have slightly different voltages when tested individually at any time during normal life. However, since all cells have approximately equal amounts of energy drain when connected in series, they will be in the same condition unless some of the cells have been recently replaced. Therefore, whenever battery replacement is necessary, replace the complete set of BA 30/U batteries. Battery life will vary depending upon how much the illumination lamp is used, but should last for approximately 100 hours of continuous operation.

When a Geiger-Mueller Tube is replaced, the AN/PDR 27 Radiacmeter must be recalibrated.

SUPERVISE RADIATION MONITORING

CONDITIONS

Given a situation when you are required to supervise radiation monitoring in a field environment provide trained operators with serviceable IM 174-series Radiacmeters, DA Form 1971-R, pencils, unit SOP, and a map of the area.

STANDARDS

1. The type of monitoring (periodic or continuous) is determined.
2. The location and specified time for readings to be taken is determined and explained to the operators.
3. Operators are given proper equipment and forms.
4. Operators perform PMCS and preoperational checks on the IM 174-Series Radiacmeter.
5. The appropriate monitoring technique (direct or indirect) is determined.
6. All readings are taken and recorded on DA Form 1971-R.
7. Operators are spot checked to ensure proper use of equipment.
8. Operators report readings to supervisor.

RADIOLOGICAL MONITORING

There are two procedures used to locate and measure radiation. These procedures are: radiological monitoring and surveying. It is very important that a commander knows the location and intensity of radiation in an area so that tactical operations can be planned. Because radiation cannot be detected by human senses, the commander must rely on monitoring and survey teams to provide this information.

The Need for Radiation Monitoring. Fallout is a hazard that may go unnoticed until it is too late. Although fallout particles are normally visible as they fall to the ground, they may be brought down in rain drops during a rain storm and thus be unnoticed. After the fallout particles are on the ground, they will become mixed with the dust and dirt common to a battlefield and not be detected by troops who move into the area later. To avoid entering or operating in radiation areas by mistake without knowing that a radiation hazard exists, the Army required a procedure known as "radiological monitoring". This is a procedure which units use to warn themselves if they are in radiation areas.

Definition. Radiological monitoring is the act of detecting the presence of radiation and measuring it with RADIAC instruments. The RADIAC instrument used in monitoring radiologically contaminated areas is the survey meter (IM174 or IM174A). In nuclear combat, monitoring is a routine duty performed wherever the unit happens to be. For instance if a platoon or company is in convoy on a road and the assistant driver of one of the lead vehicles has an IM174A radiacmeter in his/her lap, he/she is monitoring the unit's route of march for the presence of gamma radiation. Similarly, if a member of a reconnaissance patrol takes along an IM174 radiacmeter which is used in addition to the members' normal duties, he/she is monitoring the patrol's route. In a nuclear war, companies (and platoons, sections or teams if they are operating at considerable distance from the company headquarters) monitor for radiation. This is possible because the IM174A radiacmeter is available down to platoon level.

Radiological Monitors.

Radiological monitoring is basically a simple act. A soldier turns on the IM174A, waits for the radiacmeter to warm up, makes a radiation reading and reports the data to the senior individual present. Any soldier can perform radiological monitoring with about 4 minutes instruction on how to operate the radiacmeter and to whom to give the information. Operations of the IM174A is made easier because of the clear operating instructions printed on the radiacmeter itself.

Units are required to appoint or designate two or more individuals to operate each radiacmeter and to perform radiological monitoring (AR 220-58). The personnel so designated are called "Monitoring Teams" and receive special training in chemical and nuclear defense procedures.

Types of Monitoring

Periodic Monitoring. In a nuclear war, platoons and companies initially check their area for radiation whenever they move into a new position. If no radiation is detected, an occasional or periodic check of the area for radiation is performed after that. This periodic check assures the unit commander that the positions are remaining clear of a gamma radiation hazard. The unit SOP should specify when periodic monitoring is to be done. As a minimum the position should be monitored for radiation at least once every hour. The monitor checks the platoon or company CP area and may check other areas as directed.

Continuous Monitoring. Continuous monitoring is a continuous check for radiation in the units area of operations or along a route of march. The individual with the IM174A must have the radiacmeter turned on at all times. The user does not have to continually look at the meter, but should glance at it frequently and keep the senior officer or NCO aware of the radiation hazard that may exist or whenever the unit is moving into a new area where the radiation situation is unknown. Continuous monitoring should begin in all units down to platoon or section level in the following situations:

- ° When a fallout warning (NBC 3 report) is received.
- ° After a nuclear burst has been seen, heard, or reported.
- ° When ordered by the unit commander.
- ° When the unit is moving.
- ° During any reconnaissance or patrol activities.
- ° When radiation above 1 cGy(rad)/Hr is detected by periodic monitoring.

Units discontinue continuous monitoring on orders from higher headquarters, when the dose rates fall below 1 cGy(rad)/hr (except for units on the move), or when ordered by the commander.

Radiation Monitoring Techniques

Direct Monitoring. This is the simplest monitoring technique and is used to obtain outside radiation intensity readings. The monitor walks to the area of interest, holds the IM174A at waist height, turns slowly in a 360° circle, and notes the highest intensity indicated on the meter. (Holding the meter at waist level approximates the dose rate received by a standing man). The readings should be taken in open areas at least 10 meters (30 feet) from vehicles, buildings or other large objects. In cities, readings should be taken in intersections or in the middle of a street.

Indirect Monitoring. Often it is desirable or necessary to take monitoring readings inside vehicles or buildings. This may be because of the desire not to expose the monitor to high outside radiation intensities. If monitoring is

done inside a structure or vehicle, the radiation dose rate must be clearly identified as being obtained inside the structure or vehicle. Furthermore, the structure or vehicle should be described and/or its correlation factor should accompany the inside dose rate reading.

COMPUTE CORRELATION FACTORS

CONDITIONS

Given a DA Form 1971-R with inside (shielded) and outside (unshielded) dose rate readings entered on the form. You are also given a pencil and paper.

STANDARDS

Correlation factors are computed with 100% accuracy.

PERFORMANCE MEASURES

Computes Correlation Factor (CF)

- a. Identifies OD and ID.
- b. Divides OD by ID ($CF = \frac{OD}{ID}$)
- c. Shows CF work in remarks block of data sheet.
- d. Enters the CF in appropriate block.
- e. Completes the task within 2 minutes.

REFERENCES

FM 3-3

TF 3-3569

TEC LESSON 931-171-0314-F

Correlation Factor Data. All monitoring reports, except those made using the direct technique, must include correlation factor information so that the shielded dose rates can be converted to ground (outside) dose rates. To accomplish this procedure, monitors report shielded (inside) dose rates and the type of structure or vehicle in which the reading was taken. Trained NBC specialists at company and higher headquarters convert inside (shielded) to outside (unshielded) dose rates.

Some structures and vehicles have predetermined correlation factors. Inside dose rates are converted to outside dose rates by multiplying the inside dose rate by the correlation factor.

$$\text{Inside Dose Rate} \times CF = \text{Outside Dose Rate}$$

For example, a monitor located in the rear top part of the turret of the M60 tank reports a reading of 20 rad/hr. The correlation factor is 25.

$$20(D) \times 25(CF) = 500(OD)$$

However, some monitors may be located in vehicles or structures that do not have predetermined correlation factors. These factors must be computed. Trained specialists at company level determine if new correlation factors are needed.

The following procedures are used to determine an unknown correlation factor:

Step 1. Obtain one dose rate reading inside the shelter by turning a full circle and recording the highest reading. If a vehicle is used, take the reading from the position where the meter will be located.

Step 2. Obtain another dose rate reading about 10 meters outside of the shelter/vehicle. This reading should be taken within 3 minutes of the inside reading for accuracy.

Step 3. The correlation factor is then computer by the following equation:

$$CF = \frac{\text{Outside Dose Rate}}{\text{Inside Dose Rate}}$$

Step 4. For example, a company monitor is located in an open front shelter dug into the side of a hill. A nuclear burst occurs several kilometers away. About 30 minutes later the monitor detects the arrival of fallout. After the completion of fallout, the operator takes a dose-rate reading of 2 rad/hr with the survey meter at the center of the shelter and a reading of 10 rad/hr outside. Returning to the shelter, he/she reports the following:

Inside Dose Rate (ID) = 2 rad/hr

Outside (ground) Dose Rate (OD) = 10 rad/hr

The correlation factor is then determined as follows:

$$\text{Correlation Factor (CF)} = \frac{OD}{ID} = \frac{10 \text{ rad/hr}}{2 \text{ rad/hr}} = 5$$

Round CF to the nearest hundredth.

VEHICLES AND STRUCTURES	SURVEY METER LOCATION INSIDE VEHICLE	CORRELATION FACTOR
VEHICLES		
M40 TANK	TURRET-REAR TOP	25
	TURRET-FRONT	53
	CHASSIS-NEAR DRIVER	23
M48A2 TANK	TURRET-REAR TOP	27
	TURRET-REAR BOTTOM	45
	CHASSIS-NEAR DRIVER	45
M113 APC	DIRECTLY IN FRONT OF DRIVER	
	ON FRONT WALL	36
	NEAR FIRST SQUAD MEMBER	
	ON LEFT, FACING FORWARD	36
M107 SP GUN	NEAR DRIVER, LEFT SIDE	40
M108 SP HOW.	NEAR DRIVER, LEFT SIDE	36
	REAR, RIGHT SIDE	27
M109 SP HOW.	NEAR DRIVER, LEFT SIDE	35
	REAR, RIGHT SIDE	34
M577 COMMAND POST CARRIER	NEAR DRIVER, RIGHT SIDE	32
	REAR, LEFT SIDE	25
M551 ARMORED RECON/ABN ASSAULT VEHICLE	NEAR DRIVER, RIGHT SIDE	40
M114 RECON VEHICLE	COMMANDER POSITION	28
M116 CARGO VEHICLE	PASSENGER POSITION	19
M88 RECOVERY VEHICLE	COMMANDER POSITION	69
TRUCKS		
* 1/4-TON		1.2
* 3/4-TON		1.7
* 2-1/2-TON		1.7
* 4-TON TO 7-TON		2
STRUCTURES**		
Multistory Building		
UPPER FLOOR		100
LOWER FLOOR		10
Frame House		
FIRST FLOOR		2
BASEMENT		10
Shelter, Underground		
3-FOOT EARTH COVER		5000
FOXHOLES		10

* The survey meter should be held in a vertical position (face up) by the monitor who is positioned in the assistant driver's seat.

** The survey meter should be held in the center of the shelter, 1 meter above the floor.

COLLECT AND REPORT TOTAL RADIATION DOSE

CONDITIONS

Given two dosimeter readings (collected from two of your platoon soldiers while performing the same activities as the platoon in the field) paper, pencil, and the requirement to report the total radiation dose.

STANDARDS

The readings from the dosimeters are averaged and rounded to the nearest 10 cGy(rad)/hr and reported to the company daily, in accordance with the unit SOP.

PERFORMANCE MEASURES

1. Adds the dosimeter readings.
2. Divides the total of the readings by the total number of readings.
3. Rounds the figure to the nearest 10 cGy(rad)/hr
4. Reports the total radiation dose.

REFERENCES

FM 21-3, Task 031-503-4003

SAFETY AND SECURITY PRECAUTIONS

All nuclear radiation, even in small doses, has some harmful effect on the body and should be avoided whenever it is possible to do so without interfering with military operations.

Radiation exposure should be controlled to the maximum extent possible, consistent with the mission. On occasion, this may tend to restrict operation, but if exposure control is ignored, the results could be disastrous. The establishment and use of operation exposure guides will aid the commander in keeping radiation exposures at a minimum and thus assist in accomplishment of the assigned mission.

Operation Exposure Guide

The commander responsible for the radiological survey will establish an operation exposure guide for the survey party. The operation exposure guide will be expressed as a numerical value. The degree-of-risk concept provides guidance to the commander in establishing an operation exposure guide. There are three degrees of risk: negligible, moderate, and emergency. The radiation aspects of degrees of risk are discussed later.

Data From Tactical Dosimeters

The IM93()/UD tactical dosimeter is issued on the general basis of two per platoon or the smallest operation unit of interest. The platoon-size unit is the optimum size on which to maintain the radiation status. Processing of dosimetry information at the various echelons of division is described below. The tactical dosimeters will be read daily or more often if the situation dictates.

The net reading of the two platoon dosimeters will be averaged, rounded off to the nearest 10 rad, and reported to company. If there is reason to believe that the reading from one dosimeter is not representative of the platoon (for example, the person carrying the dosimeter was shielded or operating away from the platoon), then only the reading from the one representative dosimeter should be reported. An alternate unit dosimeter wearer is assigned for each dosimeter, so that the unit dosimeter may remain with the platoon when the primary wearer leaves the platoon area. The platoon reports to company only the "net" reading, that is, the amount accumulated since the last reading. In other words, the person reading the instrument makes a note of the reading each time the dosimeter is read; the next time the dosimeter is read, only the difference between the two readings is reported. The readings can be jotted down in a pocket notebook, and kept until the next reading; no permanent record need to be kept. Dosimeters are read and the readings reported before recharging the dosimeter. In this case the next reported reading (after the recharging) is the total reading. If the individual with the dosimeter is evacuated or transferred to another unit, the dosimeter stays with the platoon.

The platoon readings are reported by radio or telephone daily (or when the situation permits) by company to the S3 at battalion or similar-size unit as part of an established operational type report required by unit SOP, except when units are exposed to relatively high doses (that is, established operation exposure guide has been exceeded). In the latter case, reports should be processed without delay. The unit SOP will specify the time and method of routinely reading and transmitting this information to the next higher headquarters.

In some cases, elements of one unit are attached to another unit. For example, elements of a tank battalion are attached to another battalion or to another brigade. The radiation status of these units is kept by the unit to which they are attached. When units return to their parent unit, the parent unit is informed of their unit radiation exposure history and current status. If the parent organization desires to know the radiation status of its detached units, it contacts the headquarters of the unit to which they are attached.

Radiation Exposure Records

The operation exposure guide concept requires that radiation exposure records be maintained on all units. The most realistic unit exposure data are based on readings obtained at the platoon level because companies are often so deployed that the platoons may not be located in areas of equal radiation dose rates or remain in these areas for like periods of time.

Reporting Procedures

Unit radiation exposure records are normally maintained at battalion and higher level. Since this concept calls for platoon radiation exposure information and the company does not have the capability to properly evaluate these records, battalion will maintain radiation exposure records down to and including the organic and attached platoon. Reports on the radiation exposure status of small units are not normally forwarded higher than battalion. Battalion will forward to brigade and division its own radiation status, based on the radiation status of organic and attached companies. The table below will serve as a guide for the determination of the battalion radiation status. This information will assist both the division commander and the brigade commander in establishing operation exposure guides, degrees of risk, and composition of task forces for missions requiring further radiation exposure.

Negligible Risk. Not more than 2.5 percent of the troops receiving a negligible risk dose will experience vomiting. This dose will cause no casualties.

Moderate Risk. Not more than 5 percent of the troops receiving a moderate risk dose will experience vomiting. This dose will cause no casualties.

Emergency Risk. Not more than 5 percent of the troops receiving an emergency risk dose will have casualties; however, occurrence of vomiting may be higher. An emergency risk should be accepted only when it is absolutely necessary. It should be exceeded only in extremely rare situations that might loosely be called "disaster" situations. No attempt is made to define disaster situations. The commander must determine these extremely rare situations and decide which criteria are appropriate to use in attempting to prevent overexposure.

The command can establish an operation exposure guide using the degree-of-risk exposure chart. When doing this, the commander must consider the radiation status of the individuals on the survey party. Party members may come from different platoons within a company, or different companies within a battalion. Each party member could easily have different total past cumulative dose. When this is the case, you would use the possible exposure criteria for a single operation column. If the total past cumulative dose is known, then the second column would be used.

Establishing an Operations/Exposure Guide When the Total Cumulative Dose is NOT Known. A company commander plans to conduct a survey in a radiologically contaminated area. The survey party members come from different platoons within the company. The survey party's total cumulative dose is unknown. The commander will accept a moderate risk. What operation exposure guide will the commander establish for this survey operation?

Step 1. You do NOT know the total cumulative dose of the survey party.

Step 2. You know the commander does not want to exceed a moderate risk.

Step 3. You determine from the degree-of-risk exposure chart that an RS-1 unit can receive an additional dose of up to 30 cGy(rad) before exceeding a moderate risk.

Step 4. Based on the information above, the company commander established an exposure guide of no more than 30 cGy(rad) for the survey party in this operation.

Establishing an Operational Exposure Guide When the Total Cumulative Dose is Known. A company commander plans to conduct a ground survey in a radiologically contaminated area. A moderate risk will be acceptable. The survey party members all come from the same unit which has a total cumulative dose of 20s cGy(rad). What operation exposure guide will the commander establish for this survey operation.

Step 1. You know the total cumulative dose of the susurvey party is 20 cGy(rad).

Step 2. You know the commander will accept a moderate risk.

Step 3. Subtract the known total cumulative dose of 20 cGy(rad) from the RS-0 criterion for the desired degree of risk. In this example, the moderate risk dose is 70 cGy(rad).

Step 4. The answer from Step 3 is 50 cGy(rad). This means that the survey party can receive an additional dose of up to 50 cGy(rad) before exceeding a moderate risk.

Step 5. Base on the above information, the company commander established an operation exposure guide of no more than 50 cGy(rad) for the survey party in this operation.

An operation exposure guide for nuclear radiation is specified by the commander who ordered the survey. The control party will calculate and furnish turn-back dose rates and the turn-back dose for each ground survey party.

Turn-Back Dose Rate. The turn-back dose rate (R_{tb}) for a ground survey party read on the IM174A radiacmeter is calculated as follows:

$$R_{tb} = \frac{2 \times OEG \times \text{speed}}{\text{distance}}$$

where:

R_{tb} = Turn-back dose rate.

OEG = Operation Exposure Guide.

speed = The speed at which the survey party will travel.

distance = The distance the survey party will travel inside the fallout pattern (derived from a fallout prediction plot if no better information is available).

If the survey party encounters the turn-back dose rate, the party will, if at all possible, continue with the survey to determine if the dose rate is increasing or decreasing. If the dose rate decreases, then the survey continues. If the dose rate increases, the survey team will leave the fallout area by the same route used to enter it, unless instructed otherwise.

NUCLEAR RADIATION DEGREE-OF-RISK EXPOSURE.		
RADIATION STATUS CATEGORY ^{1,2}	TOTAL PAST CUMULATIVE DOSE ³ cGy(rad)	POSSIBLE EXPOSURE CRITERIA FOR A SINGLE OPERATION WHICH WILL NOT RESULT IN EXCEEDING THE DOSE CRITERIA FOR THE STATED DEGREE OF RISK ^{4,5} cGy(rad)
RS-0 units	No exposure	Negligible Risk: ≤ 50 Moderate Risk: ≤ 70 Emergency Risk: ≤ 150
RS-1 units	Greater than 0, but less than or equal to 70	Negligible Risk: ≤ 10 Moderate Risk: ≤ 30 Emergency Risk: ≤ 110
RS-2 units	Greater than 70 but less than or equal to 150	Any further exposure is considered to exceed a negligible or moderate risk. Emergency Risk: ≤ 40
RS-3 units	Greater than 150	All further exposure will exceed the emergency risk.
¹ Categories are based on previous exposure to radiation. ² Reclassification of units from one radiation status category to a less serious one is made by the commander upon advice of the surgeon after observing the actual state of health of the exposed personnel. ³ All exposures to radiation are considered total body and simply additive. No allowance is made for body recovery from radiation injury. ⁴ Risk levels are graduated within each status category to provide more stringent criteria as the total radiation dose accumulated becomes more serious. The exposure criteria given for RS-1 and RS-2 units should be used ONLY when the numerical value of a unit's total past cumulative dose is UNKNOWN. Otherwise, the criterion for the desired degree of risk should be obtained by SUBTRACTING the numerical value of the unit's dose from the RS-0 CRITERION for the desired degree of risk. ⁵ Each of the degrees of risk can be applied to radiation hazards resulting from enemy or friendly weapons, or both, and from initial nuclear radiation resulting from planned friendly supporting fires.		

The following is an example of how you would calculate a turn-back dose rate. The commander has established an Operation Exposure Guide(OEG) of 10 cGy(rad) for a ground survey mission. The speed at which the survey party will travel is 15 kmph. The distance the survey party will travel inside the fallout pattern is 5 km. What is the turn-back dose rate?

$$R_{t,b} = \frac{2 \times \text{OEG} \times \text{speed}}{\text{distance}}$$

$$R_{t,b} = \frac{2 \times 10 \times 15}{5} = \frac{300}{5}$$

$$R_{t,b} = 60 \text{ cGy(rad)/hr}$$

Turn-Back Dose. The turn-back dose ($D_{t,b}$) read on the IM93 or IM147 is calculated as follows:

$$D_{t,b} = \text{Turn-back dose.}$$

If the turn-back dose is encountered by the survey party and the dose rate is increasing as the party travels forward, the party will immediately leave the fallout area by the same route used to enter it, unless instructed otherwise. If the dose rate is decreasing as the party moves ahead, the survey party will continue to perform its mission along the assigned route.

The following is an example of how you would calculate a turn-back dose. The commander has established an Operation Exposure Guide (OEG) of 30 cGy(rad) for a survey mission. What is the turn-back dose?

$$D_{t,b} = \frac{\text{OEG}}{2}$$

$$LD_{t,b} = \frac{30}{2}$$

$$D_{t,b} = 15 \text{ cGy(rad)}$$

Security

Radiological survey information is of intelligence value to the enemy. Proper security procedures for the reporting of data are established by the unit SOP. For example, the unit SOP may require that location coordinates be encoded. The more detailed the briefing of the survey parties, the more easily security can be maintained.

PREPARE AND SUBMIT NBC 4 REPORTS

CONDITIONS

Given a simulated situation in which a nuclear attack has occurred and monitoring/survey data which must be reported. You are given GTA 3-6-3 revised IAW Ed 5 STANAG 2103, paper, pencil, a means of communication, and monitoring/survey data.

STANDARDS

1. The type of report being sent is reported.
2. The location where the dose rate reading was taken is reported as line Q.
3. The dose rate reading is reported as line R.
4. The date/time of reading is reported as line S.
5. The completed report is submitted.

PERFORMANCE MEASURES

1. Reports the type of report being sent (NBC 4 Nuclear).
2. Reports the location where the dose rate reading was taken (six digit coordinates as a minimum) as line Q (QUEBEC).
3. Reports the dose rate reading as line R (ROMEO).

NOTE: If the dose rate reading were not taken in the open, the conditions under which they were taken must be reported on line R following the dose rate. For example, if the reading was taken inside a vehicle, report the type of vehicle. Words, such as INITIAL, INCREASING, PEAK, SUMMARY, VERIFICATION, SPECIAL, SERIES, or DECREASING, are also reported on line R when appropriate.

4. Reports the date/time of the reading as line S (SIERRA) (Includes whether local or ZULU).

NOTE: Letter items Q, R, and S may be repeated as often as necessary.

5. Submit the completed report.

NBC 4 (NUCLEAR REPORTS)

The primary purposes of monitoring are to allow warning of all personnel of the arrival or presence of a radiological hazard and to provide a basis for prompt action by the commander to minimize the hazard. Warning is provided when the monitor detects the presence of a radiological hazard and this information is reported to the next higher headquarters.

Format For Monitoring Report

The format for monitoring reports follows the format established in the International Standardization Agreements (STANAG 2103 -- The NBC Warning and Reporting System). Within this reporting system, the NBC 4 (Nuclear) Report is used to report radiation dose rate measurements.

To prepare an NBC 4 (Nuclear) Report, you must understand:

- ° The NBC 4 (Nuclear) Report format.
- ° The information entered in each line of the NBC 4 (Nuclear) Report.

The NBC 4 (Nuclear) Report consists of the heading and lines QUEBEC, ROMEO, and SIERRA in the body of the message.

The heading of the NBC 4 (Nuclear) Report consists of the following information.

Precedence. The precedence for the NBC 4 (Nuclear) Report message is IMMEDIATE for the initial report, all other reports will be transmitted PRIORITY unless otherwise directed.

Date/Time. The date and time of the message can be sent in either local or ZULU time; however, it must be stated which time is used.

Security Classification. Radiological monitoring information is of intelligence value to the enemy. Proper security procedures for the reporting of data are established by the unit SOP.

From. This line contains the designation of the agency preparing the report.

To. This line contains the designation of the unit or units to whom the message is being sent.

Type of Report. NBC 4 (Nuclear) Report will be entered in this line.

The information contained in each line of the body of the NBC 4 (Nuclear) Report is as follows.

LINE ITEM

MEANING

QUEBEC

This line contains the location where the reading was taken. Under certain conditions, the unit SOP may require that this line be encoded.

ROMEO

This line contains the dose rate, cGy(rad)/hr. The words "initial", "increasing", "peak", or "decreasing" may be added. Correlation factor information should be included if shielded dose rate readings are reported.

SIERRA

This line contains the date/time the reading was taken. The date and time of the reading can be sent in either local or ZULU time; however, it must be stated which time is used. Usually, NATO forces operating in NATO theater will use ZULU time.

The complete format for an NBC 4 (Nuclear) Report is below lines QUEBEC, ROMEO, and SIERRA may be repeated as often as necessary.

NBC 4 (NUCLEAR) REPORT FORMAT

Precedence
Date/time
Security classification
From
To
NBC 4 (Nuclear) Report
QUEBEC (location of reading)
ROMEO (Dose rate cGy(rad)/hr)
SIERRA (date/time of reading)

When properly prepared, a typical NBC 4 (Nuclear) Report will appear as follows. One example shows lines QUEBEC, ROMEO, and SIERRA only once. The other example shows these lines being repeated.

NBC 4 (NUCLEAR) REPORT

Precedence: IMMEDIATE
Date/time: 201745Z
Security classification: UNCLASSIFIED
From: Q7R06
To: E4Z03
NBC 4 (Nuclear) Report
QUEBEC: LB123987
ROMEO: 35 Initial
SIERRA: 201735Z

NBC 4 (NUCLEAR REPORT)

Precedence: IMMEDIATE
Date/time: 161405Z
Security classification:
From: B2T03
To: N3B15
NBC 4 (Nuclear) Report
QUEBEC: TU054066j
ROMEO: 50 shielded (M113 APC)
SIERRA: 161310Z
QUEBEC: TU05606B
ROMEO: 70 peak
SIERRA: 161350Z

AUTOMATIC REPORTS

All units in the contaminated area submit certain monitoring reports automatically. These are initial, peak, and special reports. These reports provide the minimum essential information for warning, hazard evaluation, and survey planning. Reports are sent through specified channels to reach the NBCC. Nondivisional and corps units in a division area submit reports to the division NBCC.

The purpose of automatic reports is to prevent overloading of communications. Through the use of automatic reports, units are obligated, not limited, to certain types of reports. This procedure also ensures that only meaningful data are reported.

Initial Report

During continuous monitoring, the monitor takes readings outside until the dose rate reaches 1 cGy(rad)/hr. When this level is reached, the monitor notes the time and moves inside. The dose rate and time of reading are reported to the unit NBC defense team. The NBC team warns and alerts all unit personnel of the arrival of fallout. The team formats this information into an NBC 4 initial report. The word INITIAL is placed on line item ROMEO to alert the NBCC to the value of this report.

Intermediate headquarters screen and evaluate the initial NBC 4 report, if the hazard has already been reported, the precedence of the report is reduced. The report may be eliminated if several reports covering the same area have already been submitted.

EXAMPLE: NBC 4 INITIAL Report.

A unit detects arrival of fallout.

PRECEDENCE
DATE/TIME OF REPORT
CLASSIFICATION
FROM
TO
NBC 4 REPORT
QUEBEC AY 123456
ROMEO 1 INITIAL
SIERRA 021200 ZULU

Peak Report

When fallout is complete, the dose rate will level off and begin to decrease. At this time, the CF data are obtained. It is also at this time when the peak reading is evident. The information is forwarded to the unit NBC defense team. The team formats the data in an NBC 4 peak report and sends the report up through the chain of command to the NBCC. The word PEAK is placed on line item ROMEO with dose rate reading.

Intermediate headquarters do not screen these peak reports. These data are extremely important to the NBCC. The reports must not be delayed.

NOTE:

NBC 4 reports that report dose rates on line item ROMEO followed by the words increasing and decreasing are never sent unless specifically requested. It is logical to assume that the dose rate at a unit that sent an initial NBC 4 report will increase. Further, it is logical to assume that the dose rate will increase to a peak and then decrease. The computations used to normalize (convert to H + 1) the peak dose rate also converts any decreasing dose rate at that location to the same H + 1 dose rate. From this it can be seen that unsolicited increasing and decreasing reports clutter the reporting channels with useless information. Increasing and decreasing reports are used; however, this is left to NBCC SOP, special request, and instructions.

EXAMPLE: NBC 4 PEAK Report

Fallout has reached peak and begun to decay.

PRECEDENCE
DATE/TIME OF REPORT
CLASSIFICATION
FROM
TO
NBC 4 REPORT
QUEBEC AY 123456
ROMEO 10 PEAK
SIERRA 02130 ZULU

Special Reports

The NBCC SOP and other standing instructions may establish the requirement for special NBC 4 reports. These special reports are for evaluation by intermediate commanders who require special information as well as by the NBCC. Their purpose is to invite command attention to areas or conditions of serious concern. Since the operational situation, unit radiation status, and similar considerations determine the criteria for these special reports, they are not specified here. As an example, a Military Police unit may be required to change refugee routes based on contamination reaching a certain level of a road junction. The report on this radiation level is a special report.

Reports of this type may be required when the ground dose rate goes above a specified value. They may also be required when the dose rate increases after it has decreased. In this case, the word OVERLAPPING could be used on line item ROMEO. Special reports may be required after a specific period of time if the unit remains in the area.

EXAMPLE:

The radiation exposure status (RS) of several subordinate units has approached a level warranting serious concern. The RS 1 and RS 2 units may be exposed to dose rates of 10 cGy(rad)/hr or higher. This exposure over a period of hours will exceed negligible risk for RS 1 units and the operational exposure guidance established by the commander and result in the units being classified in higher RS categories. Thus, special NBC 4 reports will be required when the ground dose rate goes above 10 cGy(rad)/hr.

EXAMPLES: - NBC SPECIAL Report

PRECEDENCE

DATE/TIME OF REPORT

CLASSIFICATION

FROM

TO

NBC 4 REPORT

QUEBEC AY 456123

ROMEO 20 SPECIAL

SIERRA 081200 ZULU

Use of two words on line item ROMEO

PRECEDENCE
DATE/TIME OF REPORT
CLASSIFICATION
FROM
TO
NBC 4 REPORT
QUEBEC AY 456123
ROMEO 20 SPECIAL INCREASING
SIERRA 081200 ZULU

Directed Reports

Selected units in the contaminated area will be directed to submit NBC 4 reports. These reports are required by the NBCC to properly evaluate a radiological contamination hazard. These reports permit determination of the decay rate of fallout and the projected time of validity. They also allow determination of the soil type present in induced areas. These reports are used to determine H hour when it is not known.

The reliability of each of these calculations is directly related to the precision of the measurement of the dose rate readings. The length of the time interval over which the readings were taken is also critical. Continual development of information depends upon this data. If there is an error in the decay-rate calculation, there is a similar or corresponding error in the dose calculations.

The locations at which these readings are taken are carefully selected by the NBCC. Close coordination with the G3 is required. Selection is based upon the following factors.

- How long the unit is likely to remain in the area.
- The status of training of the unit.
- Comparison of typical soil, vegetation, and terrain present across the entire area with the proposed monitoring location.
- The tactical situation.

There are three types of directed reports. These are series, summary, and verification reports. The NBCC SOP establishes instructions for report frequency, precedence, reporting procedures, communication channels, and monitor or unit defense team, the name means dose rate reading taken in accordance with a specific procedure. The words serve the NBCC as a brief name when asking for the desired report.

Series Report

A series report consists of dose rate readings taken even 30 minutes for 2 1/2 hours followed by hourly reports. This report begins after a peak dose rate is noted at the monitor's location. The NBCC will specifically direct selected units to send these reports.

The units selected to submit series reports receive this tasking through operations channels. The SOP is referenced, and the request must specifically ask for series reports. This request is passed, ultimately, to the unit monitors. The request for series reports means to the monitor that he must take dose rate readings at 30 minutes intervals (as previously discussed). The readings are recorded on DA LForm 1971-R. However, in this case, each reading and time of reading are reported to the unit NBC defense team. The location must remain constant. The monitor continues the procedure until told to stop. The instrument should be rezeroed before each reading.

The unit NBC defense team formats the data into the NBC 4 report. The word SERIES is used in line item ROMEO. In accordance with the NBCC SOP, the reports may be sent one at a time or held until several have been collected and then reported. Intermediate headquarters do not screen or delay these reports. The reports are needed at the NBCC for fallout decay rate and other calculations.

EXAMPLE: NBC 4 SERIES

PRECEDENCE

DATE/TIME OF REPORT

CLASSIFICATION

FROM

TO

NBC 4 REPORT

LFA 3A001

UEBEC AY 654321

ROMEO 40 SERIES

TIERRA 121400 ZULU

Summary Reports

Summary reports show the radiation situation in unit areas of responsibility. For summary reports, the dose rates at locations selected by the originating unit are reported. The time each reading was taken is also given. All dose rates must be reported as outside ground dose rates.

Tasking of units to submit the summary report may be upon direction or as required by the NBC SOP at a specified time (for example H + 24 or H + 48 hours after burst). In either case, the unit must understand that it is required to submit NBC 4 summary reports. The unit NBC defense team will direct unit monitors to take dose rate readings at several locations within their subunit boundaries.

The unit monitors take dose-rate readings at locations specified by the control party or at locations of their choosings. The location, dose rate, and time of reading are recorded on DA Form 1971-R. The form is returned to the NBC defense team.

The NBC 4 summary report is created by the unit NBC defense team. The SUMMARY is used with line item ROMEO. The team ensures that the report covers the area adequately. The report is sent to the NBCC through intermediate

headquarters. At these headquarters additional data from other sources is added if available. However, reports are not delayed for this purpose.

EXAMPLE: NBC 4 SUMMARY Report

Line Q, R and S are repeated as necessary to show area's contamination.

PRECEDENCE
DATE/TIME OF REPORT
CLASSIFICATION
FROM
TO
NBC 4 REPORT
QUEBEC AY 411210
ROMEO 8 SUMMARY
SIERRA 141200 ZULU
QUEBEC AY 420220
ROMEO 10 SUMMARY
SIERRA 141205 ZULU

Verification Reports

The verification report is a unit's response to a direct request from the NBCC. In this case the NBCC needs data at a specified location near or in the unit's area. The request may be based upon a lack of data from that area. Then NBCC may also request rechecking of an unusually high dose rate. (The NBCC understands that the previous dose rate will not still exist because radioactive decay has taken place). Finally, the NBCC may request confirmation of the location of a zero dose-rate area.

A unit tasked with submitting a verification report receives specific instructions. Instructions include exact location for reading, reason for the request, and details about communications.

A unit monitor tasked to perform this monitoring uses the direct technique to take the reading whenever possible. The monitor records all data on DA Form 1971-R. The form is turned into the unit NBC defense team when the mission is completed.

The team formats the NBC 4 report. The word VERIFICATION is added to line item ROMEO. Intermediate headquarters do not screen verification reports. They are passed without delay to the NBCC.

EXAMPLES: NBC 4 VERIFICATION Report

PRECEDENCE
DATE/TIME OF REPORT
CLASSIFICATION
FROM
TO
NBC 4 REPORT
QUEBEC AY 990800
ROMEO 300 VERIFICATION
SIERRA 011300 ZULU

A unit confirms no contamination

PRECEDENCE
DATE/TIME OF REPORT
CLASSIFICATION
FROM
TO
NBC 4 REPORT
QUEBEC AY 666666
ROMEO ZERO VERIFICATION
SIERRA 112000 ZULU

Submit NBC 4 (Nuclear) Reports

One of the most valuable of the NBC 4 (Nuclear) Reports is the contact report. It is submitted whenever an initial ground dose rate of 1 cGy(rad)/hr or more is detected. Units will submit contact reports with an IMMEDIATE precedence by the quickest means available. These reports provide the basis for issuing fallout and contaminated area warnings throughout the command. Special automatic and other reports are submitted with the highest precedence consistent with other communication and operational requirements. The unit SOP also may establish the means of communication and precedence for the NBC 4 (Nuclear) Report.

The urgency of the battlefield situation will, in most cases, dictate how the report will be submitted. Methods of submitting an NBC 4 (Nuclear) Report include:

- ° Field radio
- ° Field telephone
- ° Radioteletype communications (RATT)
- ° Courier

Field Radio Method. The field radio, using the G3/S3 operations net or the G2/S2 intelligence net, is an excellent means for submitting NBC 4 (Nuclear) Reports. You must consider other battlefield operations in progress at that time, and the impact of "tying-up" the net for the period required for transmitting the message. With this means of transmission, it is possible to transmit the message to a large number of units in a single transmission.

SUPERVISE RADIOLOGICAL SURVEY

CONDITIONS

You are given a situation where a trained survey party is available with operational IM174 and IM93 radiacmeters, a watch, a mode of transportation, and a means of communication. You are able to provide to the survey party DA Form 1971-1-R, pencils, unit SOP, a map of the area to be surveyed, overlays, and marking signs.

STANDARDS

1. The type of survey is determined in accordance with (IAW) FM 3-3.
2. The technique of survey is determined IAW FM 3-3.
3. Survey team is briefed on survey mission.
4. The turn-back dose rate and dose are issued.
5. Location for obtaining correlation factor (CF) data is determined.
6. Operator is given proper equipment and forms.
7. Operator performs PMCS and preoperational checks on the radiacmeters.
8. Means of reporting and time to report are determined and issued.
9. Collected data are reported to supervisor.

REFERENCES

FM 3-3

RADIOLOGICAL RECONNAISSANCE AND SURVEYS

There are two techniques used by units to acquire the level of radiation in a contaminated area, radiological reconnaissance and radiological surveys. Radiological reconnaissance provides the commander with only an outline look at the contaminated area, normally highlighting only the boundary and its level of contamination. A radiological survey on the other hand provides the commander an in-depth picture of the contaminated area, depicting "hot" spots and uncontaminated areas. Because using the survey technique is so time consuming, let's look at radiological reconnaissance first.

Radiological reconnaissance is conducted to determine the type, extent, and intensity (dose rate) of radiological contamination. The reconnaissance mission may be performed on the ground or in the air.

The reconnaissance team is normally briefed on their mission. This briefing includes: type of reconnaissance to be used; mission objective; and the current situation in the area. Normal reconnaissance briefing techniques are used plus guidance on particular actions to take in event of discovering a radiological contaminated hazard.

Radiological reconnaissance is performed by scouts during normal reconnaissance missions. The results of radiological reconnaissance are placed on a contamination plot. In keeping with the normal understanding of "reconnaissance", reconnaissance teams initially report and may submit subsequent reports on certain aspects about the radiological contamination found. However, they do not become significantly engaged to provide detailed information. This is more properly the subject of survey operations which will be discussed later.

Ground Radiological Reconnaissance (GRR)

Ground radiological reconnaissance (GRR) is the act of detecting the presence of radiation and measuring it with RADIAC instruments before a unit moves into or through an area. The location will be reported but may not be marked on the ground depending upon type of reconnaissance and possible benefit such as marking would provide the enemy. The RADIAC instrument used in GRR is the M174 Series RADIAC meter. No special organization is required for GRR. All units appoint and train teams to conduct GRR. GRR teams will normally be the first elements to detect contamination. GRR is included in normal intelligence and reconnaissance activities, and provides the following:

- Warning of a hazard that otherwise might go undetected. Thus, GRR alerts units when they contact a contaminated area.
- Information to the unit commander about the extent or size of the hazard first contacted.
- Information to the unit commander about the location of clean or uncontaminated area.
- Information about routes which can be used to avoid the contaminated area. If total avoidance cannot be accomplished, GRR may be able to determine the lowest dose-rate route to be used while crossing the area.

Conditions for GRR

Nuclear weapons may be used on the integrated battlefield at any time. This will produce extensive fallout or more localized neutron-induced contamination areas. Any enemy with the ability to use nuclear weapons also has the ability to use radiological agents or materials which could be distributed on the battlefield, without indicators such as nuclear burst, to create additional

contamination hazards. Even the total use of air bursts without military significant fallout can cause residual contamination "hot-spots" at distant locations through rainout and washout. Because of the constant threat, all units upon initial deployment, will conduct GRR. Thus, GRR is conducted during tactical operations, patrols, and all unit movements.

Essentially, GRR actions are the same as those used in continuous on-the-move monitoring. The survey instrument is continually observed. Readings may be taken by the direct or indirect technique dependent on the level of radiation hazard and the need for protective shielding for GRR personnel.

Limitations of GRR

When a mission is given to conduct an area, zone, or route reconnaissance, the anticipated hazards are considered. Avoidance techniques and methods for complete protection from enemy action, minefields, and chemically contaminated areas exist. However, since radiation presents a penetrating hazard, the only complete protection from radiological contamination is avoidance of the area entirely. At this stage of reconnaissance, when radiological hazards are initially located, there is no indication of the maximum dose rate that may be found. The process of determining the highest dose rate may be lethal to the GRR team. The GRR team cannot conduct detailed assessment of the contamination. Keeping in mind the fact, that the GRR teams must also locate other contaminated areas during other operations. These teams must have a very low dose limit or operational exposure guide (OEG). The arbitrary setting of a high OEG will result in loss of the team. These limitations restrict the GRR team to locating only the outer limit of the contaminated area. In depth reconnaissance of the area for terrain trafficability, enemy activity, obstacles, chemical contamination, etc. must stop if a low dose limit is to be maintained. GRR is similar to finding one's way through an unfamiliar room in the dark.

GRR Techniques

In reconnaissance the most desirable information is the location of uncontaminated areas. Reconnaissance is rarely concerned with the determination of the dose rates inside contaminated areas. This task is left to radiological survey.

Dose rates found during GRR are usually of secondary value. The location of the contaminated area perimeters is of principal value and importance. These perimeters are more valuable than the dose rates in the area because the perimeter location allows units to avoid the hazard completely.

When a GRR team discovers contamination, the team notifies the commander through the unit NBC defense team. The GRR team reports the location of contamination, the dose rate, and the time the dose rate was measured. The NBC 4 report format can be used to report these data. When contamination is initially detected and reported, the word CONTACT is used with the dose rate on line item ROMEO. The word INITIAL is not associated with this dose rate.

The in-and-out process is used by the GRR team after the initial discovery. The team enters an area. Upon detecting a dose rate in the area, the team notes the reading, time, and location. The team withdraws to an uncontaminated area. A report is rendered to alert the main body or unit. The team flanks the contamination repeating the in-and-out process within the team's assigned area or zone.

Marking Areas

GRR teams mark the outer boundaries of the contamination unless told not to do so. In some cases, this may provide benefit to the enemy about troop movements. NATO markers are erected only at logical points of entry facing away from the contamination. Data are not normally recorded on the signs due to time limitations and in keeping with the expeditious nature of reconnaissance operations.

Attack Indicators

While reconnoitering for a radiological hazard, the team surveys the surroundings for indications of the reason for its existence and additional damage or obstacle indications. Some indicators are as follows:

- ° Arrival and settling of dust-like particles
- ° Tree blowdown
- ° Scorching on one side of an object
- ° Overturned objects
- ° Evidence of treetop fires
- ° Dead animals and birds
- ° Rain or snow after an airburst occurs

Washout (Rainout)

The washing out of radiological fallout particles from the air can vastly affect GRR operations. If the washout is caused by rain, the resulting contamination will collect in low areas, streams, ponds, and rivers, creating hot-spots. However, large still bodies of water will allow heavier fallout particles to settle and provide shielding. If snow causes the rainout, the area will initially be evenly blanketed. Heavy snowfall may shield indications and readings of radiation levels, but it will eventually melt and the result will be the same as that caused by rain.

A rainout area can be larger than a fallout area when given the same size attack employed as a surface burst. There is no satisfactory rainout prediction system. Essentially, predictions involve determining when it will rain, how much it will rain, and how large the raindrops (sleet, hail, or

snow) will be. Rainout can cause significant hot spot(s) in an otherwise normal fallout pattern. The GRR team should be aware of the potential for rainout and its effects on the mission.

Aerial Radiological Reconnaissance (ARR)

If the operational situation or time does not permit time-consuming ground radiological reconnaissance, aerial radiological reconnaissance (ARR) is used. An ARR team consists of a pilot and a monitor.

Aerial radiological reconnaissance is a simplified aerial survey. ARR will provide the minimum, essential information needed for contamination avoidance. This minimum information is the outer limits of the area and dose rates at points or along a route of operational interest. If conditions permit, dose rates at the location of highest contaminations are obtained.

It may be that a single unit will not be in a position to completely assess an area, even by aerial means. Radiological agents will be limited to localized areas, but fallout (as well as rainout and washout) will cover extensive areas. Due to these conditions, ARR is controlled by the NBCC as a centralized operation. This control allows greater flexibility in moving the aerial teams to areas where fallout is complete. It also eases coordination across unit boundaries and provides the data to the organization best equipped to convert, plot, and disseminate the results.

The techniques for conducting ARR are the same as those for detailed radiological surveys with the following exceptions:

- ° The ARR team selects the checkpoints, routes, and course legs when they arrive over the area. The NBCC preplans only the general area over which the ARR is conducted.

- ° The ARR provides relatively little detail, covering only those parts of the contaminated area which are of immediate operational concern. Other portions of the area can wait until detailed aerial and ground surveys are conducted.

- ° A debriefing is held by the NBCCs centralized control party after ARR is completed.

- ° Data from the ARR team may be relayed to the control party as it is determined. Loss of security is traded for timely data flow. Electronic warfare threat is always considered when electing this course of action.

Upon arrival over the fallout area, the ARR locates the edge of the contaminated area. The altitude and airspeed used are determined by the pilot. Once the edge is located, the team determines checkpoints which can be identified in the air and on the map. These checkpoints are used for route, course leg, and point techniques. An additional technique may be available to the ARR team. This technique involves flying from a known point along a compass heading while maintaining a constant airspeed. The airspeed and

duration of the flight in seconds are noted and reported to the NBCC. These data are recorded on DA Form 1971-1-R and allow plotting at the NBCC. All course legs and routes are kept as short as possible. The most important data concerns the edge of the area rather than the interior. Detailed survey later determines interior dose rates.

Since, in most cases, ARR is conducted at or ahead of the forward edge of the battle area (FEBA), careful air defense artillery (ADA) planning must be conducted to prevent high losses. Aerial security, fire support, and a host of other measures must be rapidly considered and coordinated.

The point technique permits nap-of-the-earth flight at appropriate speeds with evasive maneuvers which will minimize ADA threat during ARR. Modifying the technique to allow shielded readings from the aircraft is recommended. The ARR team must provide several air-ground correlation factor (AGCF) data readings. All shielded readings must be taken from the same height as the aerial portion of the AGCF data.

Under hostile ADA conditions, route and course leg techniques are not recommended because of their unique signature.

The ARR is best accomplished if there are several teams flying in sectors rather than a single team. This minimizes loss of data and provides the data quickly. However, it increases resource (aircraft) requirements.

There are other planning factors for ARR. Knowledge, such as that from any unit monitoring reports, about the suspected contaminated area can help determine the size or hazard of the area to be reconned.

A fallout prediction helps delineate the reconnaissance area. Several ARR teams working opposite sides of the area predicted to receive fallout can quickly locate the perimeters of the actual fallout hazard.

Night vision devices extend ARR capabilities. Reconnaissance should be delayed during precipitation and high winds. These conditions tend to change a contamination pattern.

ARR in areas with few or no landmarks for checkpoint identification will be difficult. Probably, the quickest way to identify a location in arctic, desert, or jungle areas is to mark the spot on the ground by dropping alc, ashes, paint or a similar substance from the helicopter. Several radio fixes may be needed to correlate the ground location to a map.

Fallout must be complete in the area before ARR can begin. Peak monitoring reports, if any exist from units that happen to be in the contaminated area, may indicate when fallout is complete in an area. Otherwise, the expected arrival times and completion times for fallout must be used to indicate appropriate times for aerial reconnaissance.

The status of training of the ARR team must also be considered. The best source of ARR teams is the aviation unit which supplies the aircraft. In

general, ARR teams must be better trained than survey teams. ARR teams are essentially autonomous. They must understand all facets of the operation and be capable of independent and innovative action to accomplish their mission.

The previous dose of the ARR teams is another factor. An OEG is set by the commander. The ARR team carries an IM147/PD dosimeter which is checked frequently to ensure that the operational exposure guidance (OEG) is not exceeded. Other type dosimeters are unacceptable because of their large scale. The large-scale dosimeters are graduated by 20 cGy(rad) increments. The large scale prevents accurate determination of the dose. Usually the OEG given an ARR team will be around 10 cGy(Rad). A turn-back dose or dose rate is not normally calculated for the aerial reconnaissance team. Because of the maneuverability of the helicopter, the team can immediately remove itself from a high dose rate area if necessary. However, if aerial reconnaissance is to be conducted in the vicinity of a hostile fire zone, the aerial reconnaissance team should be provided this information in case they are forced down in a contaminated area.

RECONNAISSANCE AT NIGHT AND DURING OTHER PERIODS OF REDUCED VISIBILITY

NBC reconnaissance elements conduct operations at night just as they do during the day. However, the rate of coverage is less at night. This is due to an increase in navigational difficulties; a reduction in visual observation; and during sustained operations, a decline in human endurance. As a general rule, routes can be searched just as well at night as in the day, although not as quickly. When conducting a zone reconnaissance, zones should be narrowed since command and control is more difficult at night. When performing an area reconnaissance at night or during other periods of reduced visibility, the commander should allow more time to accomplish the mission.

Illumination flares, passive night vision devices, surveillance radars, and other night observation devices offset the problems of darkness to a large degree. When illumination flares are used, they must be placed behind the enemy to silhouette them against the light. Since the enemy also uses night observation devices and places great emphasis on limited visibility concealment--during reduced visibility just as they do during good visibility. They must also use dismounted reconnaissance techniques to prevent unnecessary vehicle losses. At night or in fog, the location of moving vehicles is easy to pinpoint by sound.

RADIOLOGICAL SURVEYS

When a commander requires detailed information of a radiation hazard area a radiological survey may be conducted using either a ground survey or an aerial survey. Both types of surveys will be discussed. A radiological survey is performed by a group composed of a control party and one or more survey parties. The survey party may be organized within the company/troop/battery NBC team. The NBC reconnaissance unit also is capable of conducting radiological surveys. The material covered will apply to both NBC reconnaissance units and unit radiological survey parties.

In order for you to prepare the transportation and team equipment for radiological surveys, you must be familiar with the type of transportation to be used and the items of equipment required to conduct a radiological survey. You also must be able to inspect or check the operation of these items to ensure that all are serviceable prior to conducting the survey.

Equipment Requirements For Radiological Surveys

The following items of equipment are required to conduct radiological surveys:

- ° IM174 Series Radiacmeter
- ° IM93 or IM147 Dosimeter
- ° FM radio set
- ° Watch
- ° Maps of the area
- ° Radiological contamination markers
- ° DA Forms 1971-R and 1971-1-R
- ° Transportation

A supervisor responsible for preparations for conducting radiological surveys must ensure that all required equipment is available and operational.

IM174 Series Radiacmeter. Simplified operating instructions are provided on the operating instructions plate at the rear of the operating controls.

FM Radio Set. Depending on the radio assets of the unit at the time of the survey, the radio could either be vehicular-mounted or manpacked.

NOTE

If the radio set is vehicular-mounted, turn off the radio before starting or stopping the vehicle engine.

If the radio set is for manpack operation, open the battery bdx to make sure that a battery is installed and that the battery power connector is not damaged.

Turn on the radio, check to see if the correct frequency is set, and perform a radio check. Check to see if current Communications Electronics Operation Instructions (CEOI) are available, and the proper call sign is being used.

Watch. A watch will be required to determine the time at which the survey readings are taken. Check to see if the time on the watch is correct.

Maps. Check to see if the maps of the land areas to be surveyed are available in sufficient quantity for the survey mission.

DA Forms 1971-R and 1971-1-R. The DA Form 1971-R is used when a ground radiological survey is conducted using the point technique. Use of DA Form 1971-R was discussed in Unit 4. The DA Form 1971-1-R is used when an aerial survey is conducted or when a ground survey is conducted using the route technique. Prior to conducting a survey, you should check to see that the correct form is available in a sufficient quantity to complete the mission.

Local reproduction of these radiological data sheets is authorized. You should also check for pencils and clip board or other suitable writing surfaces.

Filling in the DA Form 1971-1-R Radiological Data Sheet Route Technique or Course Leg Technique. The definitions shown below correspond to the numbers on the 1971-1-R. A completed 1971-1-R is found later.

1. Radiological Data Sheet: State the type of survey, Ground or Air.
2. Date: Date the survey was taken.
3. Page Number: Number of page.
4. Number of Pages: How many pages you have.
5. Survey Party Designation: The name of survey party code name.
6. Monitor: Your name.
7. Map Used: Name, number, and scale of map sheet.
8. Aircraft or Vehicle Type: Type of vehicle or aircraft used for survey.
9. Instrument Type: Instrument used on survey such as IM174A/PD.
10. Route or Course Leg: The route or course leg designation.
11. Time At Start of Leg or Route: Define as local or ZULU time.
12. Time Route Completed (Ground) or Survey Height (Air): The time you completed the route, if conducting a ground survey. The height of the aircraft during an aerial survey (i.e., 200 ft).
13. Distance or time interval used to take a reading.
14. Reading Numbers are in numerical order 1-2-3-4 etc.
15. Dose Rate (cGy(rad)/hr): How much radiation was present.
16. Do Not Use: Section is for control party use only.

17. Remarks Section: The remarks block is to be used by the monitor in providing any additional information.
18. Location: Location where the readings were taken for CF.
19. Height (feet) Air only: Height aircraft was flying when reading was taken.
20. Dose Rate (cGy(rad)/hr) Inside/Air: What the dose rate was while in the air.
21. Dose Rate (cGy(rad)/hr) Outside/Ground: The reading that was taken on the ground.
22. To get your Correlation Factor Data divide outside dose (OD) by the inside dose (ID).

After completing the data sheet(s) forward it (them) to the control party.

RADIOLOGICAL DATA SHEET ROUTE TECHNIQUE OR COURSE LEG TECHNIQUE (Ground and Aerial Survey) (FM 3-12)					1	DATE	2	PAGE NO. 3	NO. OF PAGES	4																																	
SURVEY PARTY DESIGNATION					5	MONITOR (Print name)																																					
MAP USED					7	AIRCRAFT OR VEHICLE TYPE		8	DISTRICT TYPE																																		
ROUTE OR COURSE LEG DESIGNATION					10	DO NOT USE (For control party use only)		DO NOT USE (For control party use only)		DO NOT USE (For control party use only)																																	
TIME AT START OF LEG OR ROUTE					11																																						
TIME ROUTE COMPLETED (Ground) OR SURVEY HEIGHT (Air) ¹					12																																						
DISTANCE OR TIME INTERVAL USED					13																																						
RESULTS					17	READING NO.	DOSE RATE (rad/hr)	DO NOT USE (For control party use only)	READING NO.	DOSE RATE (rad/hr)	DO NOT USE (For control party use only)																																
14 1 Times of start and stop are reported for each route or portion of route completed at one time by ground survey. If a route is done in parts, use a separate column for each part. 2 DO NOT USE. For control party use only. AIR-GROUND OR VEHICLE CORRELATION FACTOR DATA <table border="1"> <thead> <tr> <th rowspan="2">LOCATION</th> <th rowspan="2">HEIGHT (Feet) AIR ONLY</th> <th colspan="2">DOSE RATE 20 (rad/hr) - 21</th> <th rowspan="2">22</th> </tr> <tr> <th>INSIDE AIR</th> <th>OUTSIDE GROUND</th> </tr> </thead> <tbody> <tr> <td>18</td> <td>19</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					LOCATION	HEIGHT (Feet) AIR ONLY	DOSE RATE 20 (rad/hr) - 21		22	INSIDE AIR	OUTSIDE GROUND	18	19																								1	15		1		1	
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RADIOLOGICAL DATA SHEET				DATE		PAGE NO.		NO. OF PAGES	
ROUTE DESIGNATION ~~GROUND SURVEY~~ (Ground and Aerial Survey) (FM 3-12)				19 MAY 1984		1		1	
SURVEY PARTY DESIGNATION				MONITOR (Print name)					
BRAVO-TWO				SSG JOE FRANK					
MAP USED				VEHICLE TYPE		DISTRICT TYPE			
GERMANY SHEET 531 1:50,000				M113		IM-174A/P0			
ROUTE OR ~~ROUTE~~ DESIGNATION				DO NOT USE (For control party use only)		DO NOT USE (For control party use only)		DO NOT USE (For control party use only)	
AA-JJ									
TIME AT START OF ~~ROUTE~~ ROUTE									
0950									
TIME ROUTE COMPLETED (Ground) OR ~~ROUTE~~ (Aerial)				DO NOT USE (For control party use only)		DO NOT USE (For control party use only)		DO NOT USE (For control party use only)	
1020									
DISTANCE OF THE ~~ROUTE~~ USED									
100 METERS									
FEATURES				READING NO.		DOSE RATE (rad/hr)		DO NOT USE (For control party use only)	
TIME OF BURST-0730				1		12			
				2		12			
				3		11			
				4		11			
				5		10			
				6		9			
				7		8			
				8		7			
				9		6			
				10		5			
				11		5			
				12		5			
				DO NOT USE. For control party use only.				12	
VEHICLE CORRELATION FACTOR DATA				15		4		15	
LOCATION		HEIGHT (Feet)		DOSE RATE (rad/hr)		C2			
		AIR ONLY		INSIDE/OUTSIDE AIR/GROUND					
CP12				5		19			

DA FORM 1971-1-R, 1 JAN 63

Replaces DA Form 1971-1-R, 1 Nov 50, which is obsolete.

CZ7845

Transportation. Ground radiological surveys are normally performed by personnel mounted in wheeled or tracked vehicles. The radiological information can also be obtained by personnel on foot; however, because of the high radiation doses to personnel, foot surveys should be conducted only under exceptional circumstances. Armored vehicles reduce the dose received by personnel and will be used whenever possible. Ground surveys lack the speed and flexibility of an aerial survey. Ground radiological surveys result in higher radiation doses to personnel, place a larger load on communications facilities, and require diversion of more personnel and equipment from the mission. However, a ground survey is independent of weather conditions, can be conducted at night, and provides more accurate information than an aerial survey. All echelons can perform ground surveys within their areas of responsibility, using regularly assigned personnel and equipment.

Sandbags placed on the floor and along the sides and rear of the survey vehicle will provide additional shielding to the survey party. As you perform before-operation checks on the vehicles in accordance with the appropriate technical manual, you should also check the placement of sandbags to ensure the greatest possible shielding is available to the survey party.

Light fixed-wing aircraft or helicopters are satisfactory for conducting aerial surveys; however, because of the slow speeds required, helicopters are the most desirable.

INFORMATION TO BE INCLUDED IN SURVEY PARTY BRIEFINGS

Normally, survey parties are briefed by the officer or NCO in charge of the control party. This briefing may be centralized or conducted on an individual basis, and may vary in detail from an area assignment to specific route and point assignments for each survey party. Basically, more general assignments facilitate the initiation of the survey, whereas the more specific assignments reduce security, communication, and interpretation difficulties. The degree of the detail of the briefing depends upon the time available to plan the survey, the feasibility of a centralized briefing, and the status of training of survey party personnel.

Briefing Guidance for Survey Parties

Survey parties will be briefed, providing guidance in the following areas.

Purpose. This will be to determine the presence and the level of fallout activity of induced radiation near ground zero, in a specified area, along a route, at a specific location, or any combination of these.

Start Time and Completion Time. The times during which the survey will be conducted will be given.

Conduct of the Survey. The data on surveys may be summarized as an overlay or a marked map by the control party. For ground surveys, the route to be followed and the locations at which readings will be taken or the distance between readings will be given.

Radiation Safety Precautions. Based on the operation exposure guide established by the commander, the control party would calculate and furnish to the survey parties the following:

- ° The turn-back dose rate at which the survey party will immediately leave the fallout area by the same route they used to enter the area.
- ° The turn-back dose at which the party will immediately leave the fallout area by the safest (lowest dose rate) route.

Recording Limitations. The minimum dose rate below which no record will be kept should be stated.

Communications. The method by which the survey data are to be communicated to the control party can vary. Data may be reported either at the time of recording or in the form of a summary table or record. In addition, the reporting method and destination to which the uncorrected results of the survey are to be sent will be given.

Current Situation. This will cover the friendly and enemy situations as they exist at the time of the briefing.

Special Instructions. Special instructions on conducting the survey may include such items as:

- ° The method in which certain dose rate readings which depart from the normal procedures (for example, the determination of correlation factors) are to be made.
- ° Marking of contaminated areas, if required.
- ° Security precautions to be taken if the survey is to be undertaken in or over a dangerous area, such as a ground survey into Threat-held terrain.
- ° If the ground survey is to be conducted as part of a reconnaissance mission, the enemy situation, type of reconnaissance, and movement technique to be used should be covered.

Guidance for the Aerial Survey Party

The control party planning the aerial survey may not be completely familiar with the survey area or the current, tactical operational situation that exists there. However, the control party has ready access to the latest information available to the headquarters conducting the survey and provides guidance to the survey party at the briefing. In addition to information about the contaminated area, the control party provides the detailed aerial survey party with the identification of the course legs or routes to be flown, the tentative survey height, and the approximate time periods during which groups the course legs or routes are to be flown. The control party also may furnish the survey party with the operation exposure guide, turn-back dose, and turn-back dose rate.

Survey Party Determinations. The aerial survey determines as applicable:

- ° The actual height above ground at which each course leg or route is to be flown.
- ° The ground speed for each course leg or route.
- ° The direction of flight for each course leg or route.
- ° The locations for determining air-ground correlation factor data.
- ° The time intervals between readings.
- ° Whether to delay the flight of a particular course leg or route.

Guidance. As a guide to the survey party in making the determination discussed above, the tactical, operation, and weather conditions existing at the time of the survey and the dose condition of the survey party should be weighted against the following factors:

- ° The slower the aircraft speed and the shorter the time interval between readings, the more accurate the results.
- ° The unreliability of survey data obtained at heights of more than 150 meters above the ground. A height of 60 meters is considered optimum.
- ° The slow response time of the IM174 Series Radiacmeter reduces reliability of the data obtained at ground speeds above 53 knots (98 kmph).
- ° The combination of ground speed and reading time interval should be selected so that the ground distance between readings is not more than 500 meters. For increased plotting accuracy, at least 10 readings between check points are desirable.
- ° Air-ground correlation factor data should be taken where aerial and ground dose rates can be read most accurately on the survey meter (for example, in the dose rate range of 5 to 10 cGy(rad)/hr).

With the guidance and procedures outlined, aerial surveys provide the control party with adequate and sufficiently reliable data. Generally, the dose rate determined by aerial survey varies from the true dose rate at the ground location because of survey meter errors, pilot errors, monitoring errors, errors due to contamination of aircraft at touchdown for ground reading, and overall system errors.

PLOT NBC 5 (NUCLEAR) REPORT

CONDITIONS

You are given an NBC 5 (Nuclear) Report, an area map covered with overlay paper, a protractor, GTA 3-6-3, and colored pencils (red, green, blue, and black).

STANDARDS

- . Grid coordinates are plotted within 200 meters of the reported locations.
- . Contour lines are drawn with the appropriate colors and labeled.
- . Dose rates are entered along each contour line.
- . Marginal data are recorded, including strike serial number, date/time of attack, and map scale.

PERFORMANCE MEASURES

- . Plots coordinates from line U (Uniform) on the map overlay.
- . Connects these points using the red pencil.
- . Labels this line as the 1000 rad/hr contour line.
- . Plots coordinates from line V (Victor) on the map overlay.
- . Connects these points using the green pencil.
- . Labels this line as the 300 rad/hr contour line.
- . Plots coordinates from line W (Whiskey) on the map overlay.
- . Connects these points using the blue pencil.
- . Labels this line as the 100 rad/hr contour line.
- . Plots coordinates from line X (Xray) on the map overlay.
- . Connects these points using the black pencil.
- . Labels this line as the 20 rad/hr contour line.
- . Enters dose rate readings along each contour line.
- . Records marginal data on map overlay.

REFERENCES

NBC 5 (NUCLEAR) REPORT

Report used to locate the area of chemical, biological, or radiological contamination or hazard. The NBC 5 (Nuclear) Report used to locate radiological contamination is discussed below.

The report is best sent as a trace or overlay if time and distance permit.

When the contamination arises from a single threat or unidentified nuclear burst, the dose rate always refers to H + 1 hour, and the letter TANGO is used. When there have been several nuclear detonations at different times or on different days and no single H + 1 hour is possible, the dose rates are reported as a specified item using letter item OSCAR. Letter items OSCAR and TANGO are, therefore, alternatives and cannot both be used in the same report.

It is not necessary or even desirable to report all four of the contours of different dose rates. Four are given to provide flexibility.

When a contour closes to form a complete ring, the first coordinate is reported at the end.

Colors used for plotting and when sending the report as a trace, are as follows:

Red for 1,000 cGy(rad)/hr.

Green for 300 cGy(rad)/hr.

Blue for 100 cGy(rad)/hr.

Black for 20 cGy(rad)/hr. (NATO uses 30 cGy(rad)/hr).

Contour lines are to be annotated with the dose rates.

When requested, decay rates are to be transmitted according to letter item R.

Users of NBC 5 (Nuclear) reports are not confined solely to the use of the letter items shown in the example; other letter items may be added at the users' discretion.

Plot NBC 5 (Nuclear) Report

The NBC 5 (Nuclear) Report may contain lines:

ALPHA	NU 007
DELTA	170800Z
FOXTROT	NB 514633
TANGO	170900Z
UNIFORM	
VICTOR	
WHISKEY	
XRAY	

Lines U, V, W, and X will list grid coordinates. When plotted and connected, they will be contour lines. The meaning of these lines are identified on GTA 3-6-2 and are shown below.

U = 1,000 cGy(rad)/hr contour line

V = 300 cGy(rad)/hr contour line

W = 100 cGy(rad)/hr contour line

X = 20 cGy(rad)/hr contour line (30 cGy(rad)/hr is used by NATO

only).

Start with line UNIFORM and plot the first coordinate given. Then plot the second coordinate given. Immediately connect the two coordinates given in line U with red pencil. Continue plotting and connecting the coordinates (as you go) given in line U. When the first and last coordinates of line U are the same the coordinates will form a closed area. When finished, label this contour line as 1,000 cGy(rad)/hr. The contour line should be "flowing" - having rounded corners and absolutely no straight lines.

The coordinates of line V, W, and X are plotted and connected the same way except line V is drawn with green; line W is drawn with blue; and line X is drawn with black. When plotting is complete, the contour lines will be basically parallel, labeled, and color coded. Marginal information is written next to the plot to identify it. Then give it to your supervisor.

NOTE: Contour lines will never cross!

CALCULATE FALLOUT DECAY

CONDITIONS

Given residual radiation decay (fallout) nomogram, a hairline and a dose rate at any time.

STANDARDS

Calculate fallout decay within $\pm 5\%$.

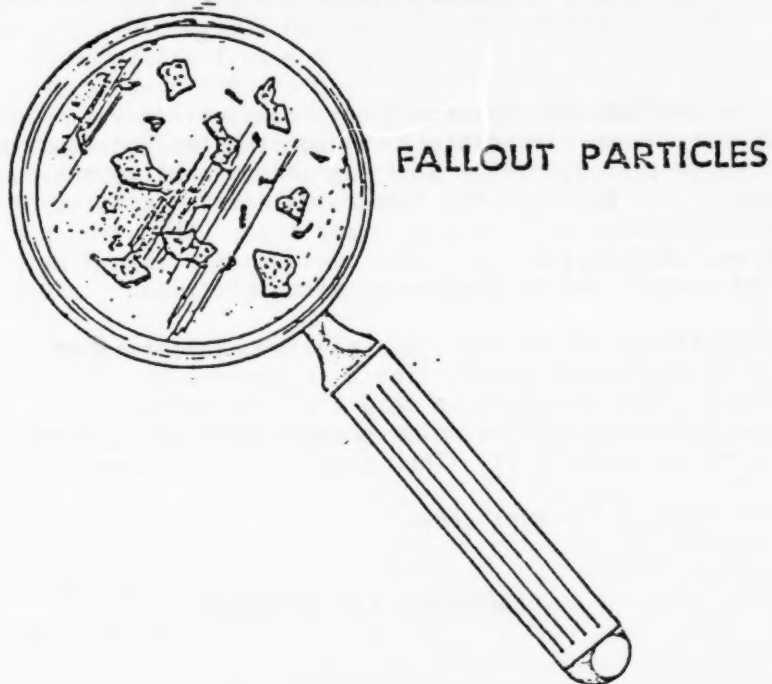
PERFORMANCE MEASURES

1. Determine R_i .
2. Determine R_t .
3. Determine t .

HAZARDS FROM FALLOUT

Radioactive Emissions from Fallout

If it were possible to obtain some fallout particles and magnify them, they would probably look like the picture on this page.



Some fallout particles are large, some are small; all look something like dust, dirt or ashes. Most of these fallout particles would be visible to the naked eye. While the fallout particles may look like dust and dirt, you must remember that the fission fragments of the nuclear explosion itself are trapped on and in some particles. These fission fragments of the nuclear explosion are radioactive. By "radioactive" we mean they are shooting out invisible rays (of radiation) in every direction. Two of the radiations emitted from fallout particles are of importance and can cause casualties in a fallout area.

One of the emissions from fallout is called "beta radiation". Of the two types of radiation from fallout, beta radiation is the least hazardous. The beta radiation from fallout particles has very little penetrating power; in fact, it cannot even penetrate ordinary clothing to a great extent. If, however, the fallout particles are lying directly on the skin, enough beta radiation can penetrate the skin to cause skin burns. These "beta burns" look like heat burns and are slow to heal. The lesson here is simple - to prevent beta burns, keep the fallout particles off the skin. When in a fallout area, keep clothing buttoned up. After leaving a fallout area, brush or wash the clothing thoroughly and bathe as soon as possible.

There is another type of invisible and dangerous radiation emitted from fallout particles which is far more serious than beta radiation. This is "gamma" radiation. Gamma radiation is the over-riding hazard from fallout and is the killer of soldiers in the fallout area. Gamma radiation has many of the characteristics of X-rays. Since most people are more familiar with X-rays, the paragraph below will compare gamma rays to X-rays.

CHARACTERISTICS OF GAMMA RADIATION

INVISIBLE
HIGHLY PENETRATING
PAINLESS
DAMAGING TO LIVING TISSUES

Invisible. X-rays are invisible and so are gamma rays. You don't see anything when you a chest X-ray or an X-ray of your arm. What his means is that you and your unit must protect yourselves against a hazard which you cannot see or detect with your five senses.

Highly Penetrating. You know that X-rays are highly penetrating. When you get a chest X-ray, they shoot the X-rays into your back and they go all the way through your body and ~~expose~~ expose the film which is in front of your chest. Gamma rays are also highly penetratin. They can easily penetrate light materials such as cloth, wood, glass and plastics. Heavy materials, however, such as steel, concrete, and dirt can stop considerable numbers of gamma rays if the heavy material is thick enough.

Painless. When you get a chest X-ray you feel nothing. Both X-rays and gamma rays are painless when they strike the body.

Damages living tissues. Both X-rays and gamma rays damage living tissues. In the case of X-rays, the damage is very small, it is directed toward a small portion of the body, and it is justified by the good it does in allowing doctors to diagnose certain medical conditions. In a fallout area, the gamma rays which enter the body are far more serious because they are uncontrolled and strike the entire body. Each gamma ray which hits your body will penetrate it and kill individual cells within your body. If enough cells are killed, you will become sick and may, in serious cases, even die.

There is one thing that gamma radiation cannot do; it cannot make other things radioactive. In other words, if gamma rays hit you or your vehicle or a can of beans in a fallout area, neither you nor your vehicle nor the can of beans will become radioactive. Objects struck by gamma rays will not give off gamma rays. Gamma radiation causes a physical kind of damage somewhat similar to sticking a pin in yourself - cells are killed, but that is all. Vehicles, tools, weapons, food and other objects which have been in a fallout area are perfectly safe to use if they are washed off to remove any radioactive fallout particles which might cling to them.

The Radiation Field

Let us now consider what it would be like to be in an area that is receiving fallout. If you are near the ground zero, fallout particles may start arriving within minutes after a surface explosion; if you are far away, it may be hours before the fallout begins to arrive in your area. Remember that militarily significant fallout is normally visible to the naked eye, looking like dirt or dust. At first, a little fallout will fall, then more and more. Eventually, when the fallout cloud has passed over, the fallout particles will arrive slower and then stop.

The fallout particles will lie on all horizontal surface, like snow. They will be on roofs of buildings, on tops of vehicles, and on the ground. These particles look like ordinary dust particles but they are not - they are radioactive dust particles - shooting out invisible beta and gamma radiation. In the area contaminated with fallout particles, the air is literally filled or permeated with invisible gamma rays and is called a "radiation field".

When you are in a radiation field, your body is bombarded by invisible and painless gamma rays from the soles of your feet to the roots of your hair. This exposure of your entire body to gamma radiation may be extremely dangerous, depending on how many gamma rays there are in the area.

Gamma rays can travel relatively long distances in the air. This means that some of the gamma rays which strike a person standing in a fallout area come from fallout particles as far as 100 meters away.

Gamma rays have a high penetrating ability. This means that a person in a tent, vehicle, or building may be subject to potential lethal radiation coming from fallout particles on the roof of the building and on the ground outside even if there are no fallout particles inside the structure. Gamma rays can easily penetrate structures made of light materials such as wood, glass, fabric and thin sheet metal. People in light or flimsy structures have little protection from gamma radiation coming from fallout particles outside the structure. This is the reason why there can never be clothing which will give any meaningful protection from gamma radiation in a fallout area. Clothing protects against beta radiation, not gamma radiation.

One of the great misconceptions in the Army is that wearing the ponch is all that is needed to protect a soldier who is in a fallout area. Wearing a poncho protects the skin against beta radiation; it does not protect against gamma radiation. Therefore, wearing a poncho in a fallout area is useful, but other actions must be taken to protect against the very hazardous gamma radiation. As was previously mentioned, only heavy materials such as earth will stop gamma rays, if the heavy material is also thick enough.

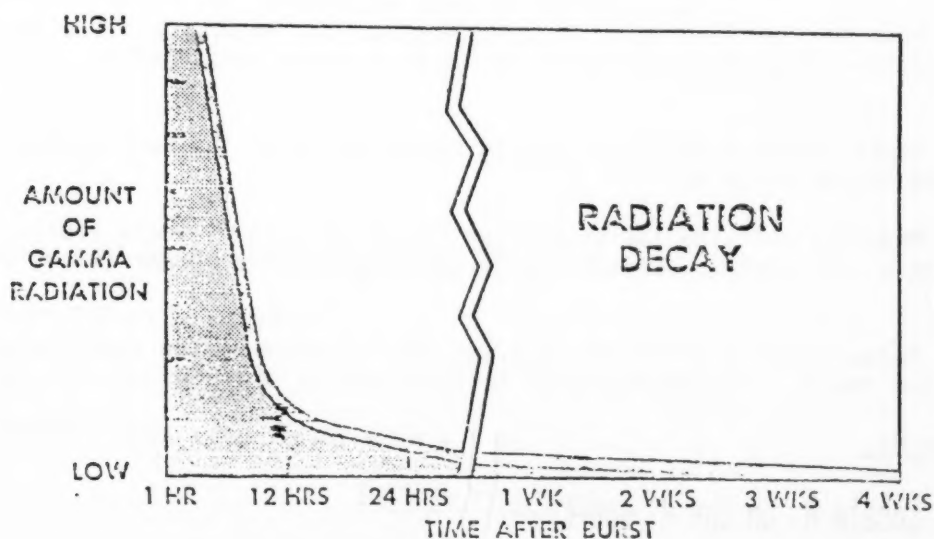
RADIATION DECAY

Principle of Radiation Decay

In the lesson on predictions, we discussed how to construct fallout predictions. Because fallout does not fall in a uniform pattern throughout the area, the concentration of radiation will also not be uniform. As a result, units must be able to determine dose rates at selected locations within the predicted area. To complicate matters even more, the dose rate at any location within a contaminated area does not remain the same but decreases with time. The rate at which the dose rate decreases is called the decay-rate.

If you stick a piece of iron in a fire until it is red hot and then take it out of the fire, what happens to it? It cools off. The exact same thing happens to fallout particles. The fission fragments are made "hot" or radioactive while in the fireball. When the fallout particles leave the fireball and begin falling down to the ground, the fission fragments decrease in radioactivity, giving off less and less gamma radiation as time goes by. The cooling off of fallout particles is called "radiation decay". Radiation decay is important because it means that a radiation field will become less hazardous as time goes by, containing less and less gamma rays. It also means that, if soldiers can stay out of a fallout contaminated area, the gamma radiation from the fallout particles will decrease, leaving a lesser hazard if the fallout area must be entered later.

The decrease in the number of gamma rays in a fallout area is quite rapid during the first 12-24 hours after a nuclear burst. The rate of decrease lessens after the first day or so, but the decrease continues, although at a slower rate. Study the diagram below which illustrates the rate of decrease (or rate of decay) of the gamma radiation from fallout particles.



Dose calculations and pattern evaluations depend upon knowledge of the decay-rate; thus the decay exponent (n) must be known. In the fallout contamination, the value of (n) will not necessarily be constant throughout a particle contaminated area although the pattern as a whole will have an average value. This average value will vary from pattern to pattern. This variance in decay is attributed to the material used to make the nuclear device. These different fission fragments, uranium and plutonium, will decay differently.

The amount of variation of n is expected to be from about 0.8 to 2.0 for fallout. The average value of n for most patterns will be 1.2, which is referred to as standard decay. Standard decay may be assumed when decay-rate estimations or determinations cannot be made. All decay calculations throughout this lesson will use standard decay. However, to fully appreciate battlefield conditions one must understand that decay variation exists.

CALCULATE FALLOUT DECAY FOR FALLOUT AREA

NOTE: Before we start with performance measures we must first understand the terms used in Rad calculations.

R_1 - This is the Dose Rate one hour after the burst or $H + 1$ Hr.

R_t - This is the Dose Rate measured at any given time after the burst other than $H + 1$ Hr.

t - Time in hours after the burst.

Determine R_1 . Use nomogram on page ____.

Step 1. Locate the time on the index scale listed 1.2 and pin the hairline down on that point.

Step 2. Rotate the hairline to the R_t reading on the R_t scale, and read the R_1 value on the R_1 scale.

Step 3. When the hairline fails to cross a value on the R_1 scale (falls off the top of the scale) multiply the R_t value by a whole number (i.e., 2, 5, or 10).

Step 4. Repeat steps a and b and divide the R_1 value by the same number you multiplied the R_t value by.

Step 5. When the hairline fails to cross the value on a R_1 scale (falls off the bottom of the scale). Divide the R_t value by a whole number (i.e., 2, 5, or 10).

Step 6. Repeat steps a and b and multiply the R_1 value by the same number you divided the R_t value by.

Determine R_t .

Step 1. Locate R_1 on the R_1 scale.

Step 2. Place your hairline over R_1 and place a sharp pencil where the two lines meet.

Step 3. Locate t or the time of the dose rate (R_t) on the 1.2 scale or index line.

Step 4. Pivot your hairline over the index line and align on the t .

Step 5. Read R_t on R_t scale where hairline intersects.

Determine t .

Step 1. Place hairline over R_t on R_t scale.

Step 2. Align with R_1 on R_1 scale.

Step 3. Read t from center of index scale.

Now that you are lost, let's start again. I will give you a problem and you may then work it out.

NOTE: In working with nomograms, CARE should be taken to be as consistent as possible when joining values with the hairline. Be sure that the hairline intersects the vertical line and the interpolated value (TICKMARK!) as closely as possible.

Example Problem 1

GIVEN: $R_t = 400$ rad/hr at $H + 6$ hr; $n = 1.2$

FIND: R_1

SOLUTION: Arrange the information similar to nomogram.

Locate $H + 6$ hr on the 1.2 or standard decay exponent line.

Pivot thru 400 on R_t scale.

Read the value on R_1 scale at the point of intersection.

ANSWR: 3260-3600 rad/hr at $H + 1$ hr.

Example Problem 2

A nuclear burst detonated at 1000Z. It is now 1400Z and your radiacmeter reads 150 rad/hr. Your commander wants to know the $H + 1$ dose rate.

SOLUTION: (Write the procedures to solve the problem)

*NOTE: When the value of "n" is not given - use $n = 1.2$ (Standard Decay)
 $n = 1.2$

ANSWER: 752-832 cGy(rad)/hr at $H + 1$ hr.

Convert R_1 dose rate reading to R_t rate readings - Given R_1 and R_t determine t .

You may be given a reading at $H + 1$ hr or once you have calculated R_t you can determine the probable intensity of radiation at any time after burst.

Example Problem 3

GIVEN: $R_1 = 1000$ cGy(rad)/hr

FIND: R_t at $H + 6$ hr.

SOLUTION: Like we did before arrange your information similar to your nomogram.

$$n = 1.2$$

R_t t R_1

$$H = 6 \text{ hrs } 1000 \text{ cGy(rad)/hr}$$

ANSWER: 110-122 cGy(rad)/hr at $H = 6$ hrs.

Example Problem 4

GIVEN: $R_1 = 200$ cGy(rad)/hr
 $t = H + 25$ hrs

FIND: R_t

Locate $H + 25$ hours on the 1.2 decay exponent scale. Pivot and align 200 on the R_1 scale.

OH NO! What do I do? -- It's off Scale!

NOTE: When this occurs multiply by a common whole number (normally 2, 5, or 10). Then divide by the same number.

SO!! Align 2000 (200×10) on R_1 scale.

Read T_t scale at intersectiona and divide by 10.

ANSWER: 4.0-4.4 cGy(rad)/hr at $H + 52$ hours.

Example Problem 5

GIVEN: $R_1 = 200 \text{ rad/hr}$
 $R_2 = 4 \text{ rad/hr}$

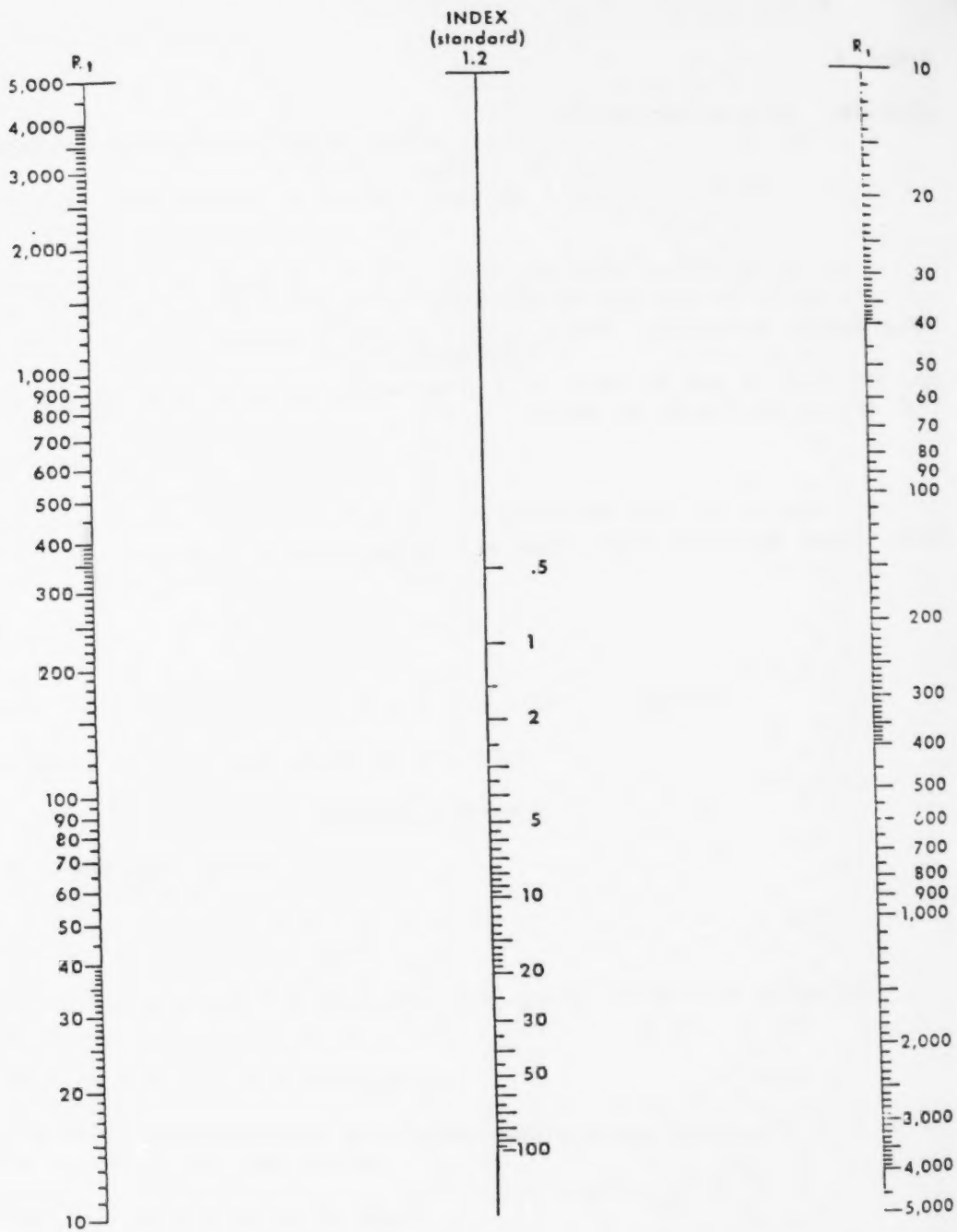
FIND: t

SOLUTION: Record information.

"More Monkey Business"! There is no 4 on the R_2 scale!

Multiply both R_1 and R_2 value by a given whole number greater than 1.
That will bring the R_2 on scale.

NOTE: Never multiply time. Time will always stay the same.



CROSS A RADIOLOGICALLY CONTAMINATED AREA

Nuclear weapons effects may be classified as initial and residual. This text deals with procedures and techniques to be used to mitigate the residual effects of nuclear weapons upon field operations. For the purpose of this ext, we will discuss only two of the five main types of bursts. These two types are the air burst and the surface burst; both may occur as a single burst or multiple bursts. An "air burst" is defined as one in which the weapon is exploded in the air at an altitude below 100,000 feet, but at such a height that the fireball does not touch the surface of the earth. A "surface burst" is regarded as one which occurs either at, or slightly above the actual surface of land or water. Although the air burst may be preferred for immediate casualties, the surface burst is potentially the greatest casualty producer due to the amount of fallout or rainout produced which contaminates large areas for extended periods of time.

Fallout or rainout can have a major impact on tactical operations due to their ability to produce casualties and restrict troop movement over large areas; delay logistical support, and impose the requirement of tremendous effort by the engineer and other service support units to decontaminate or neutralize the area.

Fallout, by definition, consists of rock, soil, and other material which is vaporized and taken into the fireball as well as large amounts of dirt, dust, and other particles stirred up by the strong afterwinds and drawn up into the fireball as it rises. These particles settle to the ground as radioactive debris of various sizes and is then called fallout.

Rainout is a condition which occurs when the nuclear cloud is within or below a rain cloud. The nuclear cloud may be the product of a surface burst but the principal source will be the air bursts with yields up to 60 kilotons: When precipitation of any kind passes through the nuclear cloud, the dust-like particles are washed from the cloud with the rain. The resultant contamination will have the same effect as fallout except that the rate of decay will be different. Whenever fallout is discussed, the reader should also consider the characteristics of rainout.

Fallout contains alpha, beta, and gamma radiation. Alpha particles are not considered a tactical military hazard because they will not penetrate the skin. Beta particles are considered a negligible hazard if they are not in direct contact with the skin, and a limited hazard if they are in direct contact. After extended periods of exposure the beta particles may cause skin damage ranging from reddening of the skin to open sores similar to third degree burns. The third and last type of radiation, gamma, is a severe tactical military hazard due to its ability to readily penetrate the body, causing injury or even death. Since the primary personnel hazard is whole body gamma exposure, an analysis of the emitted gamma radiation dose rate is used to determine the hazard exposure.

Neutron-induced activity is another residual radiation hazard which may be produced by surface bursts, but is more likely to be a result of air burst.

CALCULATE TRANSMISSION FACTOR

CONDITIONS:

Given the mission to compute the transmission factor for a shielded environment, paper and pencil.

STANDARDS:

Transmission factor is determined within ± 5 percent.

PERFORMANCE MEASURES:

1. Take an outside (ground) dose rate (OD) reading.
2. Take an inside (shielded) dose rate (ID) reading.
3. Use the formula shown below for calculating the transmission factor.
4. Record TF for future reference.

Neutrons are produced by all-nuclear weapons with some types of weapons creating more neutrons than others. Some of these neutrons are captured by the various elements in the soil under the burst. As a result of this neutron capture, some of these elements become radioactive. Generally these elements emit beta particles and gamma radiation. They do not emit neutrons. These radioactive hazards are as dangerous as those found in fallout and may remain radioactive for extended periods of time following the explosion. If at all possible, the area directly below the burst point should not be crossed immediately after the burst.

In a neutron-induced target area, the soil is radioactive to a depth of about 0.5 meters while fallout is only a deposit of radioactive dust on the surface. The decontamination of a fallout area is extremely difficult while the decontamination of a neutron-induced activity area is logistically impossible.

It is necessary for commanders to have a means of predicting the amount of radiation in the area of operations. The commanders must attempt to control the amount of personnel radiation exposure while accomplishing their mission within the guidelines set by the higher headquarters operational exposure guidance (OEG).

The actual amount of radiation received by the personnel is indicated by the unit dosimeters and noted on the unit radiation dose status chart after the mission has been accomplished.

Transmission Factors (TF)

A transmission factor (TF) is that fraction of the outside dose or dose rate that is received inside the enclosure that provides the shielding. TFs are always less than 1.0. A TF is used to find the reduction in dose or dose rate received when personnel are protected from radiation. TFs are always determined in operational situations by the unit NBC defense team.

The TF is calculated using the following formula:

$$TF = \frac{\text{Inside dose or dose rate (ID)}}{\text{Outside dose or dose rate (OD)}} \quad (TF = \frac{ID}{OD})$$

This formula can be arranged to yield ID and OD as shown below:

$$ID = OD \times TF \quad \text{and} \quad OD = \frac{ID}{TF}$$

The principal use of the TF is to find the ID. This process requires multiplication.

A list of precalculated TFs is given below. These TFs are established for the most exposed occupant location using gamma radiation from cobalt-60. Since cobalt-60 radiation is almost twice as penetrating as the radiation from fallout, actual TFs should be much smaller which means that the personnel would have more protection than indicated. These TFs are not used under operational situations unless no other TF data exists.

Transmission factors for residual radiation

ENVIRONMENTAL SHIELDING	TRANSMISSION FACTOR
VEHICLES	
M60 TANK	0.04
M48A2 TANK	0.02
M41 TANK	0.1
M113 APC	0.3
XM 104 SP HOW.	0.5
M107 SP GUN	0.4
M108 SP HOW.	0.3
M109 SP HOW.	0.2
M110 SP HOW.	0.4
XM106 SP MORTAR	0.3
M125A SP MORTAR	0.3
M114 RECON VEHICLE	0.3
M116 CARGO VEHICLE	0.6
M548 CARGO VEHICLE	0.7
M88 RECOVERY VEHICLE	0.09
M578 RECOVERY VEHICLE	0.3
M577 COMMAND POST CARRIER	0.3
M551 ARMORED RECON/ABN ASSAULT VEHICLE	0.2
M728 COMBAT ENGR VEHICLE	0.04
TRUCKS	
1/4-TON	0.8
3/4-TON	0.6
2-1/2-TON	0.6
4-TON TO 7-TON	0.5
STRUCTURES	
Multistory Building	
UPPER FLOOR	0.01
LOWER FLOOR	0.1
Frame House	
FIRST FLOOR	0.6
BASEMENT	0.1
URBAN AREA (In Open)	0.7*
WOODS	0.8*
SHELTER, UNDERGROUND (3-foot earth cover)	0.0002
FOXHOLES	0.1

* These factors do not apply to ground survey dose rates.

Figure 5-3. Transmission factors for residual radiation.

Precalculated TFs are provided for instruction and practice use. They are also used by commanders and operations personnel to judge the relative shielding ability of various vehicles and shelters.

The primary objectives of the commander are to accomplish the mission while keeping the total dose as low as possible. There are four principles of protection which the commander may use to reduce total dose exposure. These four principles are listed below:

- ° Avoid the area. Boundaries of contaminated areas are located through radiological reconnaissance teams. Whenever possible, troops should skirt the boundary of the contaminated area, or if available, aircraft can be used to by-pass the contaminated area. When the area cannot be avoided and the use of aircraft is not consistent with the mission, a route should be selected that can be traversed with exposure at the lowest dose rate possible. Under these circumstances, the number of personnel committed to the mission should be held to a bare minimum.

- ° Reduce exposure time. Operations are planned to minimize time spent in contaminated areas. This can be accomplished by selecting the shortest, easiest to cross route which offers high speed movement across the area.

- ° Delay time of entry. This will allow for the natural decay of the contamination areas. Each hour of delay reduces the dose rate for all decay rates. Estimates of the decay rate can be made using the 7:10 decay rate rule of thumb. This rule applies to $n = 1.2$ decay only and states that a dose rate decreases by a factor of ten for every sevenfold increase in time. For example, if the dose rate is 100 cGy(rad)/hr at $H + 1$, it will decay to 10 cGy(rad)/hr by $H + 7$. If n is greater than 1.2, then the dose rate at $H + 7$ would be less than 10. If n is less than 1.2, then the $H + 7$ dose rate would be higher than 10.

- ° Shield. All vehicles should have increased protection if possible. One good method of increasing protection is to place sandbags on the tops, sides, and floors of armored personnel carriers (APCs) and on the floors and sides of cargo trucks.

If it is necessary to occupy or cross an area which contains residual radiation before the natural decay rate has had time to render the area safe, then the commander may use all four principles to minimize the total dose rate to which personnel are exposed.

Crossing Fallout Areas

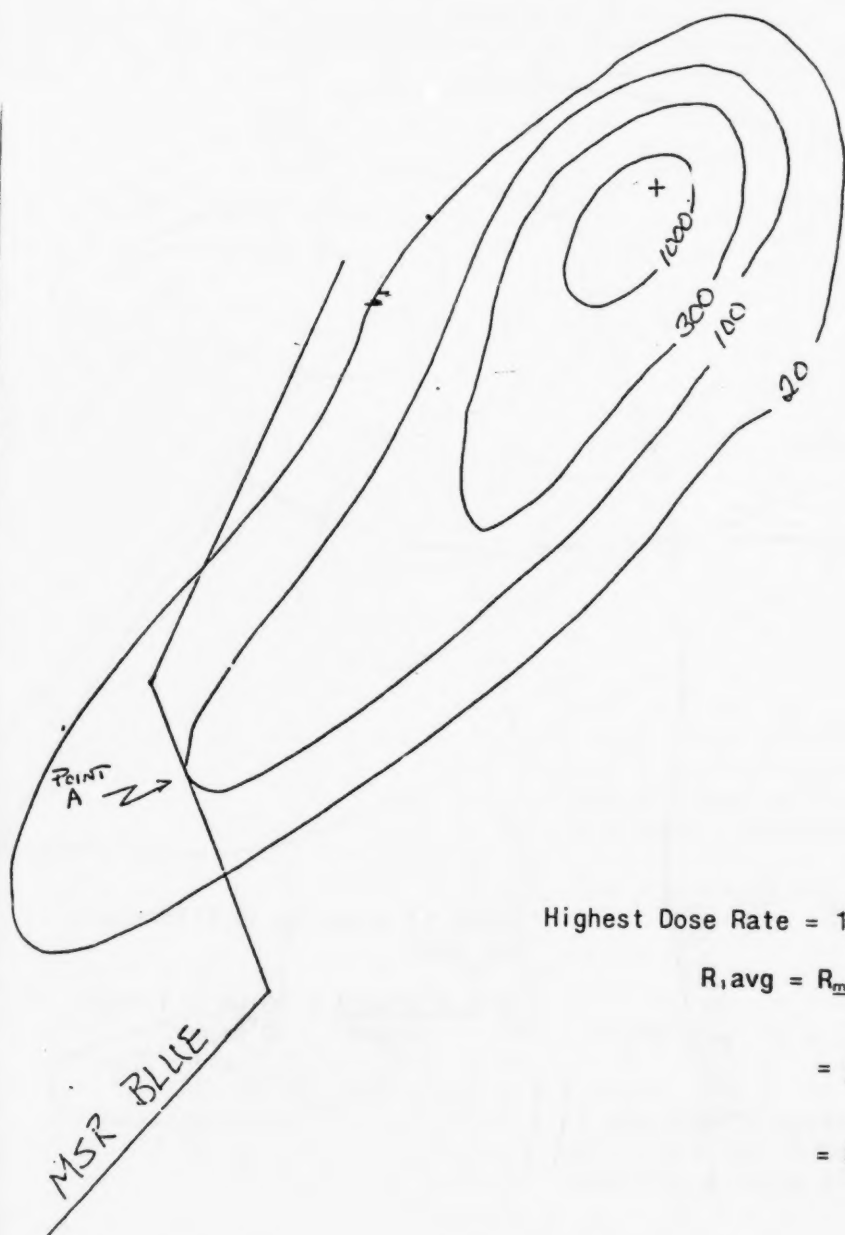
In analyzing the problems of crossing a contaminated area it is necessary to determine an average dose rate for total dose calculations. This is because the dose rate will increase as the center of the area is approached and decrease as the far side is approached. A reasonable approximation of the average dose rate can be made by using half of the highest dose rate obtained.

This is written mathematically as:

$$R_{avg} = \frac{R_{max}}{2}$$

where: R_{avg} = average dose rate

R_{max} = highest dose rate encountered or expected to be encountered.
This text uses H + 1 dose rates or R_{avg} only. See the following example of this calculation.



Highest Dose Rate = 100 rad (Point A)

$$R_{avg} = \frac{R_{max}}{2}$$

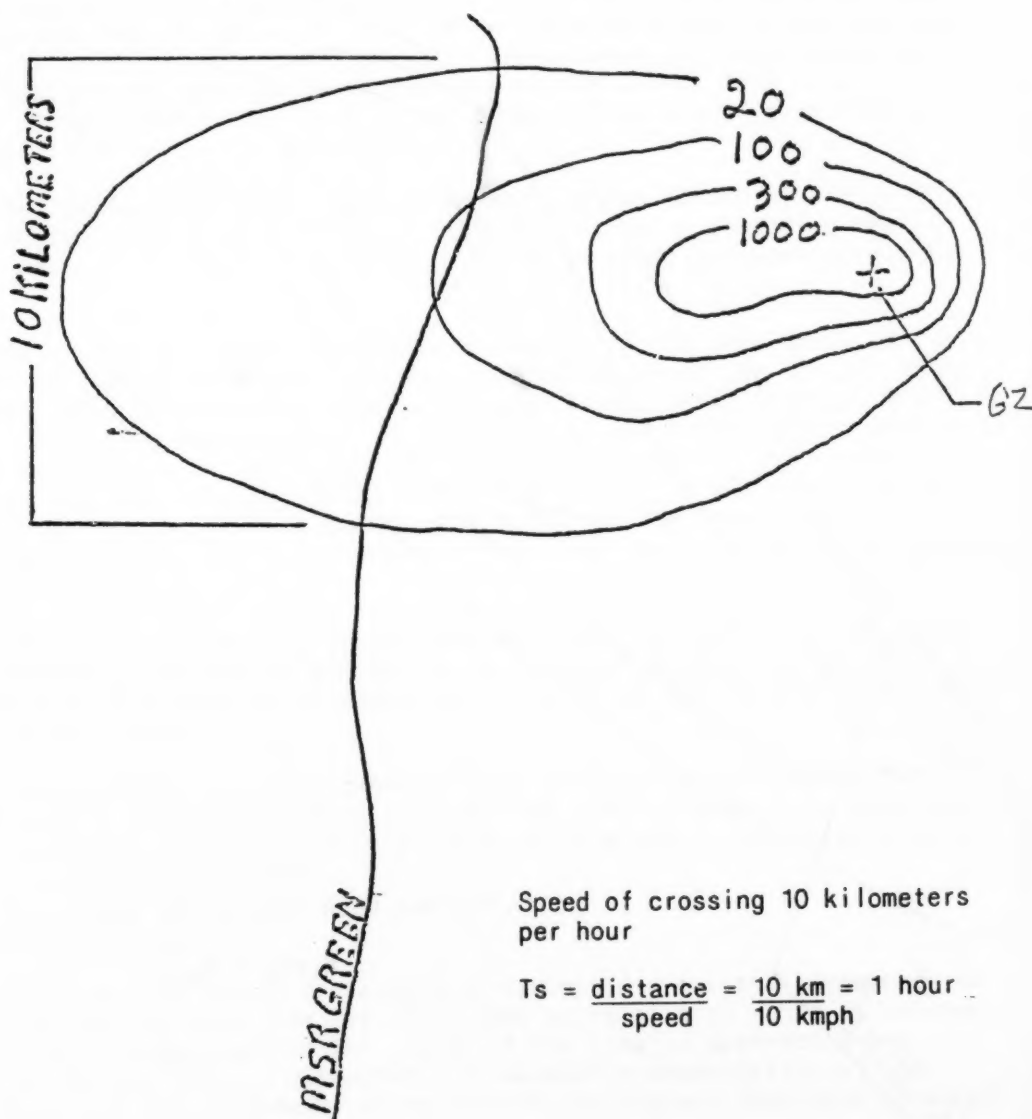
$$= \frac{100}{2}$$

$$= 50 \text{ rad}$$

After computation of the average dose rate, the commander must calculate the length of exposure for the time of stay in the contaminated area. This is determined by dividing the length of the crossing by the constant speed of the crossing. In planning, the average speed of crossing may be used.

$$T_s = \frac{\text{distance}}{\text{speed}}$$

where: T_s = Time of stay

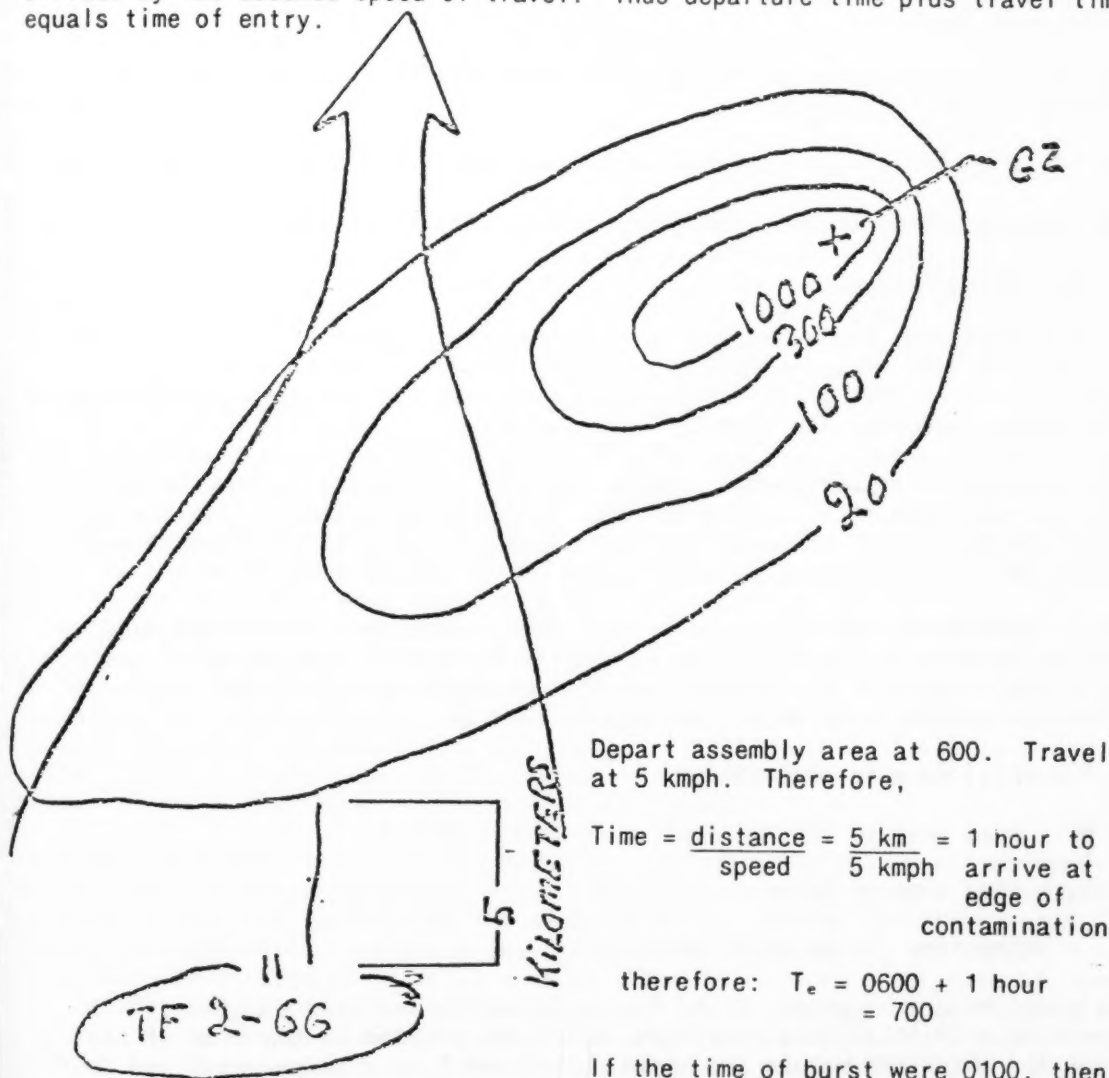


Speed of crossing 10 kilometers per hour

$$T_s = \frac{\text{distance}}{\text{speed}} = \frac{10 \text{ km}}{10 \text{ kmph}} = 1 \text{ hour}$$

When a unit must cross a contaminated area it is given an OEG by the higher command. The unit commander then calculates various entry times and stay times and chooses the opportune times that will keep the dose below the OEG. To make these calculations the average dose rate must be computed and transmission factors for vehicles applied to total doses or dose rates.

For a coordinated attack in which all action is scheduled to begin at a specified time, it may be necessary for a unit to cross a fallout area. When this occurs, the unit must calculate the time of entry (T_e) into the contaminated area. The unit will depart a known location at a specific time after the burst and travel at a constant speed until it reaches the contamination. Travel time is determined by the distance to the contamination divided by the assumed speed of travel. Thus departure time plus travel time equals time of entry.



COMPUTE TOTAL DOSE

CONDITIONS: Given appropriate nomogram, the dose rate (R_1) at $H + 1$, the stay time (T_s) in hours, the time of entry into fallout area (T_e) in hours after burst, hairline, pencil and paper, with the requirement to calculate the total dose received in a fallout area.

STANDARDS: Total Dose (D) is determined within ± 5 percent.

PERFORMANCE MEASURES:

1. Connect reading on the (T_e) scale and reading on the (T_s) scale with the hairline.
2. Pivot the hairline at its point of intersection with the index scale to reading of the (R_1) scale.
3. Read number on (D) scale and record as the total dose.
4. Inform commander or supervisor of calculated total dose.

Total Dose Calculations

Total dose nomograms are based upon anticipated decay rates of $n = 0.2$ to $n = 2.0$. They are used to solve total dose, time of entry, and time of stay calculations in fallout areas. Total dose nomograms are not used to determine the R_1 ; decay nomograms are used for this purpose.

For the purpose of training unit level personnel, a standard decay rate of $n = 1.2$ will be used for all calculations. These calculations will allow unit personnel to give their commanders an approximate value that can be used until battalion level or higher notifies the unit of the actual decay rate.

The total dose nomograms relate total dose, $H + 1$ dose rate, stay time, and entry time by means of an index scale which is located in the center of the nomogram and is used as a pivoting line for calculations. The other four value scales on the nomogram are defined as follows:

° D = total dose in cGy(rad)/hr

° R_1 = dose rate in cGy(rad)/hour after burst ($H + 1$)

° T_s = stay time in hours

T_e = entry time (hours after burst)

In applying the given values, D and R_1 , or T_s and T_e are used together. When working with total dose nomograms, start the problem on the side of the nomogram for which two values are known. If D and R_1 are given, start on the left side. If T_s and T_e are given, start on the right side. Do not begin a problem by joining D or R_1 with either T_s or T_e .

Since the R_i must already be known before total dose nomograms can be used and the index scale is known; if any two of the remaining three values (D , T_s , T_e) are known, the missing value can be found by using the nomogram.

Total Dose Nomogram Usage Problems

Example Problem

Given: $R_i = 200 \text{ cGy(rad)/hr}$

$$T_e = H + 1.5 \text{ hours}$$

$$T_s = 1 \text{ hour}$$

$$n = 1.2$$

Find: D

Answer: 90 cGy(rad)/hr

Solution: Select the $n = 1.2$ total dose nomogram. Connect $H + 1.5$ hours on the T_e scale and 1 hour on the T_s scale with a hairline. Pivot the hairline at its point of intersection with the inlet scale to the 200 cGy(rad)/hr on the R_i scale. Read $D = 90 \text{ cGy(rad)/hr}$ on the total dose scale.

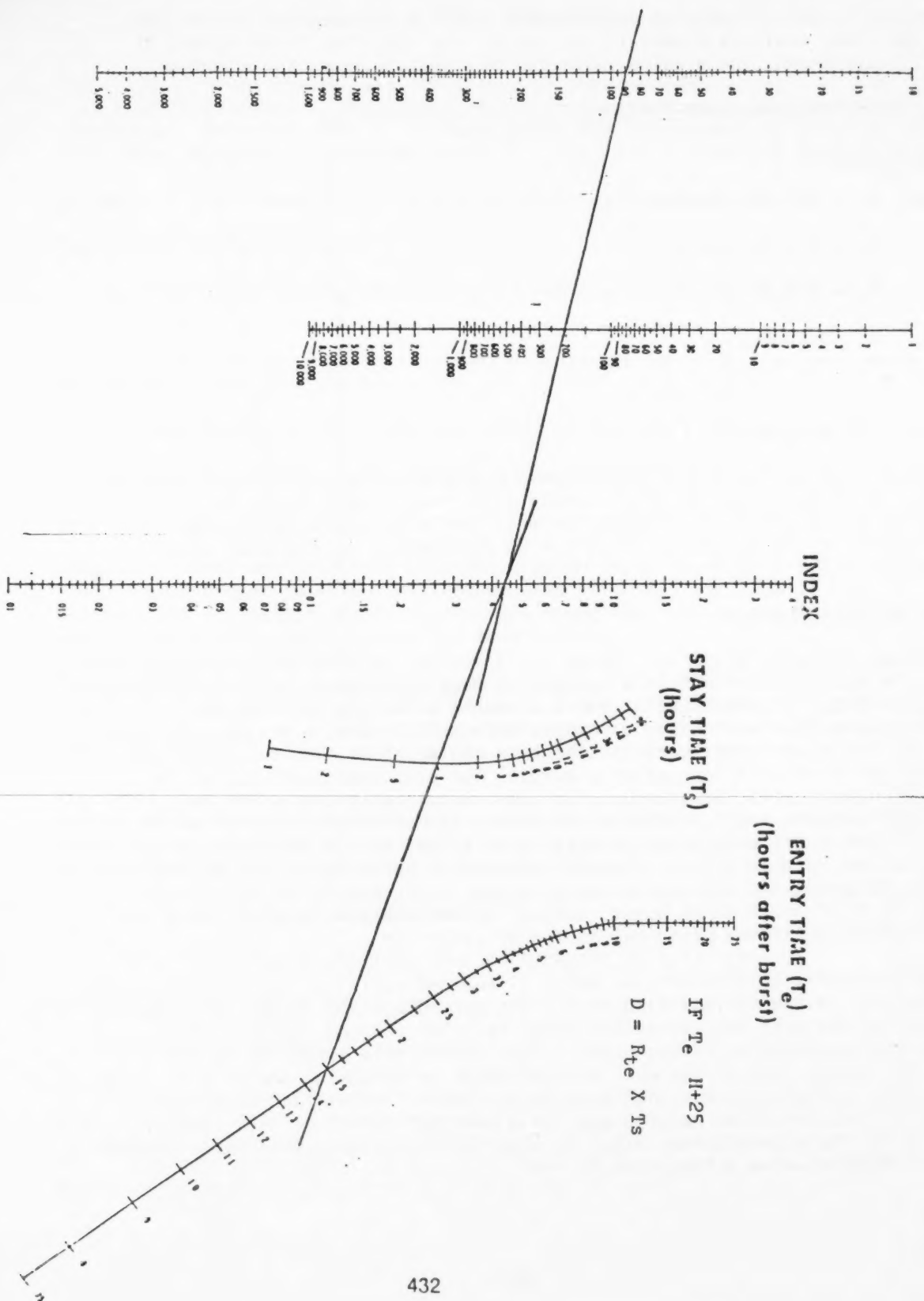
Decay of Induced Areas

The decay characteristics of induced radiation are considerably different from those of fallout. Fallout is a mixture of many substances, all with different rates of decay. Induced radiation is produced primarily in aluminum, manganese, and sodium. Other elements, such as silicone, are less important because they either emit very little gamma radiation or they decay rapidly during the first half hour after a burst. The principal contribution to induced radiation is radioactive aluminum. Aluminum is one of the most abundant elements and is found in almost all soils. Radioactive aluminum has a half-life of 2.3 minutes which means that almost all of the radioactive aluminum has decayed within 1/2 hour after burst until 10 to 20 hours after burst, manganese and sodium are the principal contributors of radiation. After 10 to 20 hours after burst, sodium, which decays with a half-life of about 15 hours, is the principal source of radiation.

The most important factor in the decay of induced radiation is the composition of the soil in the contaminated area. The percentage, by weight, of elements present in the soil determines the decay rate for induced radiation areas. Since soil composition varies widely, even in a single area, the actual chemical composition of the soil must be known to determine the rate of decay of induced radiation. For this purpose, all soils are divided into four types. Since the actual soil composition will not be known, soil type II (which has the slowest decay rate) is used for all calculations until advised by the NBCC to use a different soil type.

TOTAL DOSE
(D)

DOSE RATE
(R₁)



Unit Procedure

Neutron-induced radiation areas are to be avoided whenever possible. All air bursts are assumed to create an induced hazard area. Bursts may be employed in multiple burst packages which will create induced areas very near to one another. These areas may even interlock. To avoid these areas of contamination, the commander must know the boundaries and extent of the suspected area. GZ for an air burst should not be crossed for 24 to 96 hours after burst. Routine occupancy of an area of induced radiation area is possible 2 to 5 days after burst. In the case of occupancy, even low dose rates become significant due to the accumulated dose acquired over the period of exposure. The commander should seek the least contaminated area, dosimeters are checked frequently (once an hour is adequate) to monitor the radiation hazard. When crossing a contaminated area, the lowest dose-rate consistent with the mission is selected. This option of route selection may be influenced by unpassable terrain such as mountains or swamps and obstacles such as fires, rubble, or blown down trees. There may also be a limited number of available routes or the mode of movement may be restricted.

If there is an option for the method of crossing an induced area, it should be selected in the following priority:

- ° Use armored vehicles and APC.
- ° Drive wheeled vehicles.
- ° Move on foot. (Least desirable).

If possible, all vehicles used in crossing should be sandbagged to increase shielding. Cargo vehicles should be sandbagged on the floors and sides. APCs are sandbagged on top and bottom. Sandbags should be filled with uncontaminated soil.

COMPUTE TOTAL DOSE

When working with the total dose nomogram, always start the problem on the side of the nomogram for which values are known. Never begin a problem by joining D or R_i with either of the time values.

Given $R_i = 200 \text{ cGy(rad)/hr}$
 $T_e = H + 1.5 \text{ hours}$
 $T_s = 1 \text{ hour}$

Find Total Dose (D)

Solution: On the nomogram, connect $H + 1.5$ hours on the T_e scale and 1 hour on the T_s scale, with the hairline at its point of intersection with the index scale, to 200 cGy(rad)/hr on the dose rate (R_i) scale.

Answer: 85.5 - 94.5 cGy(rads)

To determine the total dose personnel will receive in a radiologically contaminated area (standard decay), but protected/shielded in a shelter, foxhole, or vehicle, you need certain information:

- ° Total Dose - (D).
- ° Dose Rate (reference to 1 hour after the burst or $H + 1$ or R_1).
- ° Time of stay [amount of time stayed in the area of contamination (T_s)].
- ° Time of entry [time after H hour or time after the burst (T_e)].
- ° Index scale - Is a line that is used to establish a pivot point between D and R_1 and T_s and T_e .
- ° Transmission Factor - The TF for the shelter, foxhole, or vehicle the personnel are in.
- ° Calculated dose - total shielded dose (D_s).
- ° Remember:
 - (1) D = Total Dose
 - (2) R_1 = $H + 1$ Dose Rate
 - (3) T_s = Time of Stay
 - (4) T_e = Time of Entry
 - (5) TF = Transmission Factor
 - (6) D_s = Total Shielded Dose

° Any of the values (1-4) may be determined from the nomogram if the other three values are known. D_s or dose shield is calculated by multiplying the total dose (D) by the transmission factor (TF).

~~Turn to the nomogram on next page. The figure you see is used for predicting TOTAL DOSE received while operating in a fallout area.~~

NOTE: When using this nomogram always use a dose rate referenced to $H + 1$ hour (R_1).

If the available dose rate was taken at a time other than $H + 1$ hour (R_1), the value of R_1 (dose rate at $H + 1$ hour) may be found by using the procedures mastered in Lesson 2.

OK! Lets see if we can clear up these muddy waters by demonstrating what we expect you to do.

Example Problem 1.

Given: $R_1 = 200$ cGy(rad)/hr.
 $T_e = H + 1.2$ hrs
 $T_s = 6$ hrs

Find: $D = ?$

Solution:

Like in Lesson 2 lets arrange the information in the order of the nomogram.

D	R_i	T_s	T_e
?	200 cGy(rad)/hr	6 hrs	H + 1.2 hrs

Step 1. Enter the nomogram on the side of the index line that we have complete information and connect 1.2 hour on T_e scale and 6 hour on T_s scale.

NOTE: Where the hairline crosses the INDEX SCALE.

Step 2. PIVOT at the point of intersection with INDEX scale and align 200 on R_i scale.

Step 3. Read value on D scale.

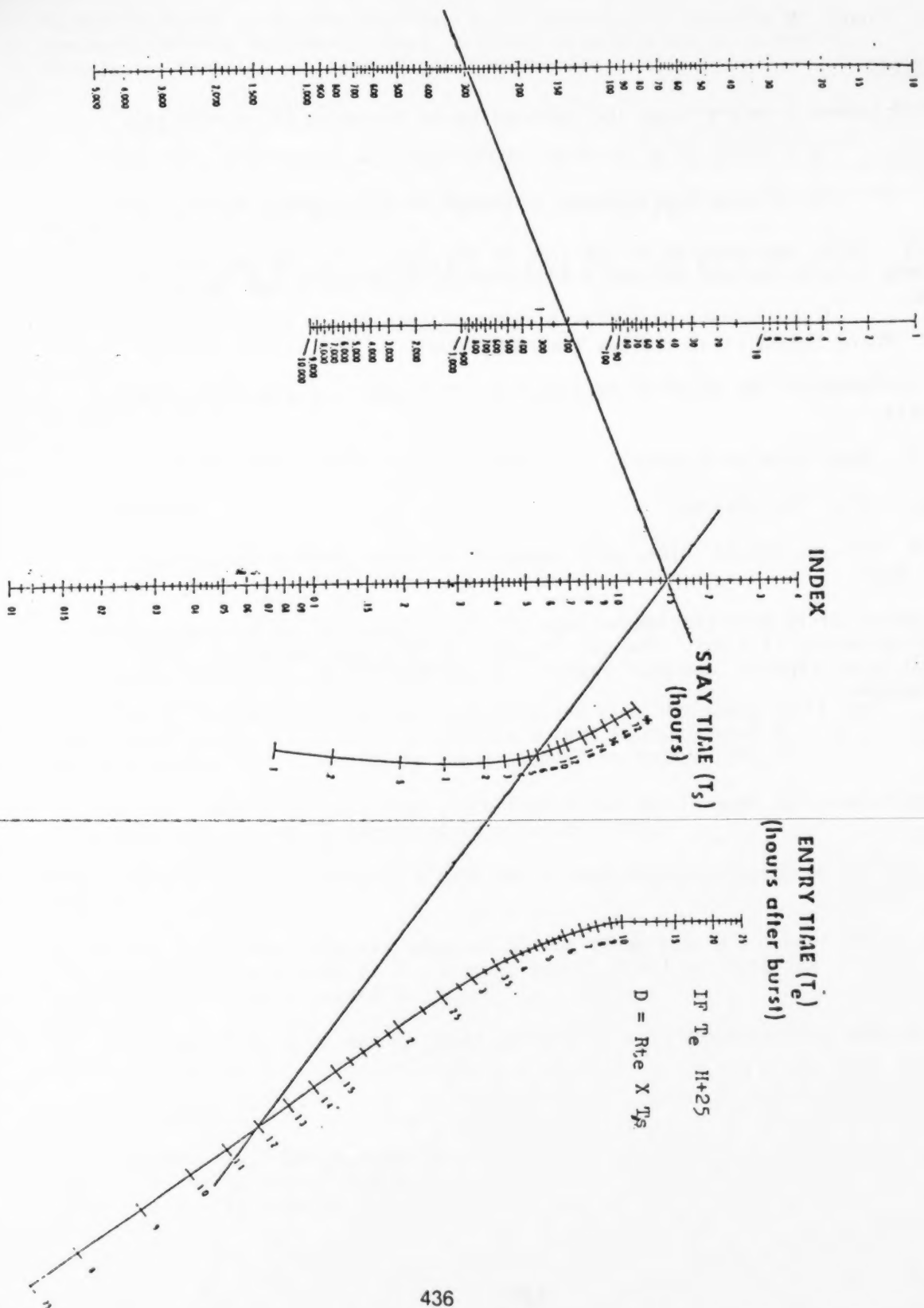
Answer: 275 - 305 cGy(rad)

Step 4. Now you should inform your commander or supervisor of calculated total dose.

That was a fairly easy problem because all the information was straightforward. But in actuality it's not. You get information from your commander, from nuclear burst reports, and your report. So you must be able to identify your information.

TOTAL DOSE
(D)

DOSE RATE
(R_i)



Example Problem 2.

Your commander calls you in and says "Look, NBC Specialist, I want to know what the total dose PV2 Repose will receive in a fallout area if the dose rate at $H + 1$ was 100 cGy(rad)/hr and if he entered the area 2 hours after burst and stays in the area 3 hours.

Solution: Let's follow the same steps as our previous problem and compute D.

Step 1. Record known information.

D	R_1	T_s	T_e
?	100 cGy(rad)/hr	3 hrs	$H + 2$ hrs

Step 2. Enter the nomogram on the side of the index scale where we have NO unknowns.

Align 2 on T_e scale and 3 on the T_s scale; pivot at the intersection of INDEX SCALE.

Step 3. Next pass the hairline through 100 on the R_1 scale.

Step 4. Read value on D scale.

Answer: 69-76 cGy(rad)

Let me give you one more problem for you to work through on your own before we continue.

Example Problem 3.

Your unit must enter an area contaminated with fallout at $H + 4$ hours. Your mission will require you to remain in the area for 6 hours and the known dose rate at $H + 1$ hr was 300 cGy(rad)/hr.

You must determine the total dose personnel will receive while in the area.

Step 1. Record known information:

D	R_1	T_s	T_e
?	300 cGy(rad)/hr	6 hrs	$H + 4$ hrs

Step 2. Enter the nomogram on the side of the index scale where we have no unknowns. Align 4 on T_e scale and 6 on T_s scale, pivot at the intersection on the index scale.

Step 3. Next pass the hairline through 300 on the R_1 scale.

Step 4. Read value on D scale.

Answer: 180.5 - 199.5 cGy(rad)

CALCULATE TIME OF ENTRY FOR FALLOUT AREAS

CONDITIONS:

Given appropriate nomogram, commander's guidance on total dose (D), the dose rate (R_1) at $H + 1$ hr, stay time (T_s) in hours, hairline, pencil and paper, with the requirements to calculate the optimum time of entry for a fallout area. FM 3-12 is available.

STANDARDS. Time of entry is determined within ± 5 percent.

PERFORMANCE MEASURES:

NOTE: If the available dose rate was taken at a time other than $H + 1$ hr, the value of R_1 may be found by using the residual radiation decay (fallout) nomogram found in FM 3-12.

1. Connect reading on the D scale and reading on the R_1 scale with the hairline.
2. Pivot the hairline at its point of intersection with the index scale to reading on the T_s scale.
3. Read number of T_e scale and record as the time of entry (hours after burst).

So far, you have learned to determine the Total Dose (D) which is an unshielded dose. To determine the total shielded dose (D_s) we simply add one more step.

Example Problem 4.

Your unit must enter an area contaminated with fallout at $H + 3$ hours. You are required to stay for 10 hours. You will be inside the basement of a house with a (TF) Transmission Factor of 0.03. What will the ($\bar{D}_s$) calculated dose be if the dose rate at $H + 1$ was 450 cGy(rad)/hr?

Step 1. Locate information given.

D_s	TF	D	R_1	T_s	T_e
?	0.03	?	450 cGy(rads)/hr	10 hrs	$H + 3$ hrs

Step 2. Working from the right side of the nomogram align the T_e and the T_s

Step 3. Pivot on the index line and align the R_1 value; read the D off the D scale.

D_s	TF	D	R_1	T_s	T_e
12.9-14.1 cGy(rad)	0.03	450 cGy(rad)	450 cGy(rad)/hr	10 hrs	H + 3 hrs

Step 4. To find the D_s we simply multiply the total dose (D) by the transmission factor (TF).

$$\begin{array}{rcl} D & \times & TF = D_s \\ 450 \text{ cGy(rad)} & \times & 0.03 = 12.9 - 14.1 \text{ cGy(rad)} \end{array}$$

CALCULATE TIME OF ENTRY FOR FALLOUT AREAS

When working with the total dose nomogram, always start the problem on the side of the nomogram for which two values are known. Never begin a problem by joining D or R_1 with either of the time values.

EXAMPLE

Given Total dose (D) = 20 cGy(rad)
 Dose rate (R_1) = 100 cGy(rad)/hr
 Stay time (T_s) = 1 hour

Find time of entry (T_e)

Let's slow down once again and really look at this task. It's about the same as the last one, isn't it? All we are doing is reading in reverse.

In many cases the commander has received a mission from higher headquarters with time restrictions to accomplish a particular mission.

The commander will want to know at what time the unit may enter the area (T_e) and not exceed the "COMMAND DOSE" -- the TOTAL dose a commander feels the troops can be allowed to absorb and not reduce their combat effectiveness for a particular combat mission and for future combat missions.

You use the same nomogram for time of entry calculations. The basic principles are the same except that now you will enter the nomogram from the left of the index line, as this is the side with complete information. Let's practice:

Example Problem 1:

Given: D = 30 cGy(rad)
 R_1 = 150 cGy(rad)/hr
 T_s = 1.5 hrs

Find: T_e = ?

Solution: Identify given information.

D	R _i	T _s	T _e
30 cGy(rad)	150 cGy(rad)/hr	1.5 hrs	?

Step 1. Enter the nomogram on the side of the index line that we have complete information. Enter the left side. Align 30 on the D scale and 150 on the R_i scale.

NOTE: Hairline crosses the index line.

Step 2. Pivot at point of intersection with index line and align 1.5 hours on T_s scale.

Step 3. Read value on T_e scale.

Answer: H + 4.42 - 4.88 hours

Try the next one on your own and see if you can find the solution.

Example Problem 2:

A nuclear burst occurred at XX1400Z. Your commander has been given the mission of securing an LZ. The commander estimates that the job will take 5 hours. The monitoring data shows an H + 1 hr dose rate of 200 cGy(rads)/hr. The command dose for the men involved is 40 cGy(rads). At what time can the unit enter the area and not exceed the command dose?

CALCULATE TIME OF EXIT FOR FALLOUT AREAS

CONDITIONS:

Given a multiplication factor graph, FM 3-12, time of detonation, location of contaminated area (map of area), average transmission factor, time (in hours) required to move out of contaminated area, pencil and paper, with the requirement to calculate the optimum time for exit of fallout area.

STANDARDS: Optimum time of exit is determined within ± 5 percent.

PERFORMANCE MEASURES (PM):

1. Determine the average transmission factor (TF) for the fallout shelter (As) and the average transmission factor for the evacuation vehicles (Ae).
2. Divide the average transmission factor for the fallout shelters (As) by the average transmission factor of the evacuation vehicles (Ae).

$$\frac{As}{Ae}$$

3. Enter the vertical axis of multiplication factor chart at the value determined.

4. Move horizontally along the $\frac{A_s}{A_e}$ ratio to the curved line. Move straight down to the horizontal axis and read the multiplication factor (MF).

5. Multiply the multiplication factor (MF) by the evacuation time (T_e) in hours. The product is the optimum time, in hours after detonation, that the unit should leave its shelters and evacuate the area.

Step 1. ?

D	R_1	T_s	T_e
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Step 2. ?

Step 3. ?

Step 4. ?

Answer: $T_e = H + 11.7 - 12.9$ hours

Practice Problem 3:

Given: $D = 50$ cGy(rad)
 $R_1 = 100$ cGy(rads)/hr
 $T_s = 24$ hours

Find: $T_e = ?$

D	R_1	T_s	T_e
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Answer: $T_e = H + 14.52 - 15.96$ hours

CALCULATE TIME OF EXIT FOR FALLOUT AREAS

NOTE: Evacuation time is how long it takes to move from your present location to the clear area.

Here are some more new terms for you to learn.

TF = Transmission factor

A_s = Average transmission factor for the shelters you are in.

A_e = Average transmission factor for the evacuation vehicles.

T_e = Estimated time required to clear contaminated area (time of evacuation).

MF = Multiplication factor.

T_{opt} = Optimum time of exit.

Determine the average transmission factor (TF) for the fallout shelter (As) and the average transmission factor for the evacuation vehicles (Ae).

In this case all troops are in foxholes (As) TF = .1 and we will use 2 1/2 ton trucks (Ae) TF = .6 to evacuate the area.

Divide the average transmission factor for the fallout shelter (As) by the average transmission factor of the evacuation vehicles.

$$\frac{As}{Ae} = \frac{.1}{.6} = .167$$

NOTE: When dividing, carry only to the third decimal.

Take the value you received, .167, and look on the left side $\frac{As}{Ae}$ of the chart and locate that value.

Move horizontally across the chart until you hit the curved line. Then go straight down the chart and read your multiplication factor (2.8).

Multiply the multiplication factor 2.8 by the time it will take you to clear the area (Tev). In this case we will say it will take 2 hours to clear the area. (MF x Tev = T_{opt} or 2.8 x 2 = 5.6). Your optimum time of exit will be H + 5.6 hrs or about 5 hours and 36 minutes after the burst.

Example Problem 1:

GIVEN: As = 0.1 Foxholes
Ae = 0.6 2 1/2 Ton Trucks
Tev = 2 hours

FIND: T_{opt}

Solution: $\frac{As}{Ae} = \frac{0.1}{0.6} = .167$

Multiplying Factor (MF) = 2.8

$$MF \times Tev = T_{opt}$$

2.80 x 2 hrs = H + 5.6 hours or about 5 hours and 36 minutes after the burst.

Example Problem 2: Let's try a little something different this time.

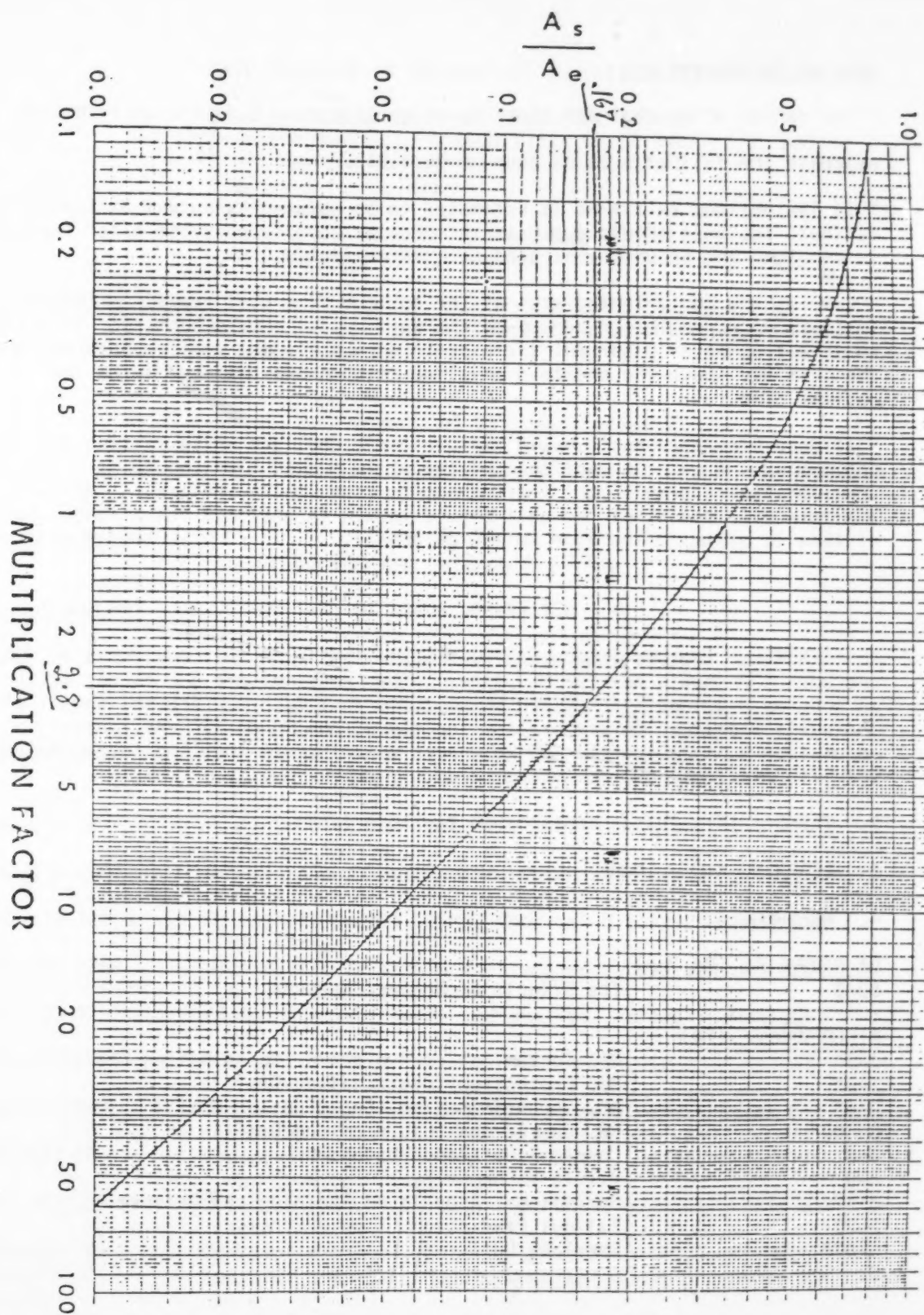
GIVEN: As = .1 (Foxhole) and .7 Urban area (in open).
Ae = .8 (1/4 Ton Truck)
Tev = 2 hours

FIND: T_{opt}

Solution: $\frac{A_s}{A_e} = \frac{.4}{.8} = .5$ $MF = .51$

$$MF \times T_{ev} = T_{opt} \quad .51 \times 2 = H + 1.02 \text{ hour}$$

Where did you get .4 from? Before you go wild, listen. You had two forms of shelters, the foxhole and urban area (in open) so, you added them together and divided the answer by two (.1 + .7 = .8 divided by 2 = .4) that gave you an average for the two. OK? Then we continued on as before



Special Considerations

- ° For ratios of $\frac{A_s}{A_e}$ that are close to or greater than 0.5, the unit should evacuate the fallout area as soon as possible.
- ° If the optimum exit time is estimated to be before the actual arrival of fallout, the unit should evacuate the area as soon as possible after fallout is complete and an uncontaminated area is available.
- ° Leaving the contaminated area at the optimum time will result in the smallest dose possible received by the unit. If the unit commander is willing to accept up to a 10 percent increase in dose above the minimum possible dose, the unit may leave the shelters any time between one-half and twice the optimum time.
- ° If possible, personnel should improve their shelters while waiting for the optimum exit time. The estimate of the optimum exit time should be recalculated if significant improvement is made in the shelters. Improved shelters will mean that the unit should remain in shelters for a longer period of time to minimize the dose to the personnel.

REVIEW NBC ANNEX TO UNIT SOP

1. GENERAL: In this lesson you will learn that each unit must have an SOP and each SOP should have an NBC Annex. The format of the SOP is not critical as long as provided information is in consonance with the accomplishment of the units mission. In preparation for operations in an NBC environment, a supervisor must review the SOP to ensure all elements required to accomplish specific missions have been considered.

2. TASKS: This lesson contains no testable tasks.

3. LEARNING AIDS: None

4. REFERENCES:

DA PAMPHLETS (DA Pam)

50-3

The Effects of Nuclear Weapons

FIELD MANUAL (FM)

3-3*

NBC Contamination Avoidance (Coordinating Draft)

3-4*

NBC Protection (Coordinating Draft)

3-5*

NBC Decontamination (Coordinating Draft)

3-100*

NBC Operations (Coordinating Draft)

3-8

Chemical Reference Handbook

3-9

Military Chemistry

3-12

Operational Aspects of Radiological Defense

3-22

Fallout Prediction

3-87*

Chemical Unit

8-9	NATO Handbook on the Medical Aspects of NBC Defensive Operations
21-2	Soldiers Manual of Common Task Skill Level 1
21-3	Soldiers Manual of Common Tasks Skill Level 2,3, and 4
21-1	Field Hygiene and Sanitation
21-11 (TEST)	First Aid for Soldiers
21-40	NBC Defense
21-48	Planning and Conducting Chemical, Biological, Radiological (CBR), and Nuclear Defense Training)

FIELD CIRCULARS (FC)

3-3-1	Warning, Reporting and Predicting Chemical Hazards (TBP)
3-12-1	Nuclear Burst Data
3-12-2	Radiological Monitoring
3-12-3	Radiological Recon
3-12-4	Operational Aspects of Residual Radiation

* Distribution made to Post, Division, and selected chemical staffs for review

TRAINING CIRCULARS (TC)

3-1	How to Conduct NBC Defense Training
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TECHNICAL MANUALS (TM)

3-216	Technical Aspects of Biological Defense
3-220	Chemical, Biological and Radiological (CBR) Decontamination
3-240	Field Behavior of Chemical, Biological, and Radiological Agents
3-4230-204-12&P	Operator and Organizational Maintenance Manual: Decontaminating Apparatus, Portable, DS-2, 1-1/2 Quart, ABC-M11
3-4240-279-10	Operator's Manual Mask, Chemical-Biological, Field, ABC-M17-Series
3-4240-279-20&P	Organizational Maintenance Manual M17-Series Protective Mask
3-4240-280-10	Operator's Manual, Mask, Chemical-Biological, M24 and M25 Series
3-4240-280-23&P	Organizational and DS Maintenance Manual M24 and M25 Series Protective Mask
3-6665-225-12	Alarm, Chemical Agent, Automatic: Portable, Manpack, M8
3-6665-261-14	Operator's, Organization, DS & GS Maintenance Manual: Power Supply, Chem Agent Alarm, M10
3-6665-261-24P	Organizational, DS, & GS Maintenance Repair Parts & Special Tools List: Chem Agent Alarm, M10
3-6665-273-20	Organizational Maintenance Manual: Installation Kit for Chemical Agent Alarm
3-6665-302-20P	Organizational Maintenance Manual: Automatic Chemical Agent Alarm
3-6665-307-10	Operator's Manual, Detector Kit, Chemical Agent, M256
3-6665-311-10	Operator's Manual, Paper, Chemical Agent Detector: M9

3-9905-001-10	Operator's Manual, Marking Set, Contamination: Nuclear, Biological, Chemical (NBC)
11-6665-209-15	RADIAC Sets AN/PDR 27J, L, and Q
11-6665-213-12	Operator's Manual, Radiacmeter IM93/PD, IM93/UD IM93A/PD, and IM147/PD
11-6665-224-15	RADIAC Set, AN/PDR27P
11-6665-224-20P	Organizational Maintenance Repair Parts & Special Tools List: AN/PDR27P
11-6665-228-15	RADIAC Set, AN/PDR-27G
11-6665-228-20P	Organizational Maintenance Repair Parts & Special Tools List: AN/PDR27G
11-6665-230-15	RADIAC Set, AN/PDR-27R
11-6665-230-20P	Organizational Maintenance Repair Parts & Special Tools List: AN/PDR27R
11-6665-232-12	Operator's and Organizational Maintenance Manual: IM174A/PD and IM174B/PD
11-6665-232-20P	Organizational Maintenance Repair Parts & Special Tools List: IM174A/PD and IM174B/PD

TECHNICAL BULLETINS (TB)

43-180	Calibration Requirements for the Maintenance of Army Material
SIG 226-8	Chargers, RADIAC Detector, PP1578/PD and PP1578A/PD
SIG 226-9	Field Expedient for Charging IM93/UD and IM147/PD

SUPPLY BULLETINS (SB)

3-30-2	Chemical-Biological Canisters and Filter Elements: Serviceability lists.
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COMMON TABLE OF ALLOWANCES (CTA)

8-100	Army Medical Department Expendable Supplies
50-900	Clothing and Individual Equipment (Active Army, Reserve Components, and DA Civilian Employees)
50-909	Field and Garrison Furnishings and Equipment
50-970	Expendable Items (Except Medical, Class V, and Repair Parts)

REVIEW NBC ANNEX TO THE UNIT SOP

Standing Operating Procedures (SOP) are locally published procedures providing guidance to members of the unit on command policy or methods of accomplishing the mission. SOPs are required at all levels of command. A unit SOP normally will contain an NBC defense annex. An SOP can have an annex dealing only with chemical and biological (CB), and another annex dealing with the nuclear radiation aspects, or it can be combined into a single NBC defense annex.

Each unit must have Standing Operating Procedures (SOP) in NBC Defense procedures that are in consonance with the accomplishment of its mission. These procedures may vary from unit to unit depending upon their mission, equipment, and prior exposure to NBC agents. The list of tasks below should not be considered all inclusive, but minimum requirements that should be

included in each SOP. FM 3-10, FM 3-12, FM 3-22, FM 21-40, and Unit ARTEP describe the criteria in detail and should be used as the guides for each area to further explain if required. Below are some of the areas the NBC defense annex should cover. For the purposes of reviewing the SOP in preparation for operations in an NBC environment, select the appropriate mission and review the listed considerations.

° Prepare for operations in an NBC environment.

- Considerations:
- 1 - NBC defense equipment is issued and operational
 - 2 - MOPP
 - 3 - Decon equipment is deployed
 - 4 - ABC-M11s are mounted/filled

Unit

- Considerations:
- 1 - Use of cover and concealment/shielding
 - 2 - Dispersal in a noncircular deployment pattern
 - 3 - Unit movement is planned/conducted during limited visibility

° Prepare for a nuclear attack

- Considerations:
- 1 - Warn subordinate elements
 - 2 - Establish a ground messenger service
 - 3 - Vehicles disperse/place in defilade
 - 4 - Electronic devices turned off/grounded/shielded
 - 5 - Periodic monitoring is initiated
 - 6 - Personnel seek shelter
 - 7 - Equipment, POL, munitions, food, and water are shelter

° Prepare for friendly nuclear strike.

- Considerations:
- 1 - Acknowledge warning
 - 2 - Implement protective measures

° Respond to the initial effects of a nuclear attack.

- Considerations:
- 1 - Take immediate action
 - 2 - Reestablish communications
 - 3 - Send NBC 1 report and follow-up
 - 4 - Administer to casualties/fatalities
 - 5 - Damage assessments forwarded
 - 6 - Implement continuous monitoring

° Respond to the residual effects of a nuclear attack.

- Considerations:
- 1 - Prepare simplified fallout prediction
 - 2 - Implement continuous monitoring
 - 3 - When fallout arrives submit NBC 4 report
 - 4 - Maintain total dose records, forward per SOP

Depending on Mission and OEG.

Stay in place

Move (Determine when best time to move)

° Conduct radiological reconnaissance.

- Considerations:
- 1 - Determine type of survey (Point, route, etc.)
 - 2 - Determine turn-back dose and dose rate
 - 3 - Determine sites for obtaining correlation factor
 - 4 - Determine location of decon point/determine decon requirement using AN/PDR27
 - 5 - Reporting requirements to survey team defined
 - 6 - Marking requirements briefed to team
 - 7 - Vehicle preparation

° Cross a radiologically contaminated area.

- Considerations:
- 1 - Route of least exposure is determined using an NBC 5 Report
 - 2 - Advance party is dispatched/performs route survey/determines time required to cross.
 - 3 - Turn-back dose/dose rate determined
 - 4 - Maximum shielding of vehicles
 - 5 - Determine decon requirements using AN/PDR27
 - 6 - Unit total dose is reported to higher headquarters

° Perform radiological decontamination (unsupported).

- Considerations:
- 1 - Establish decon priorities
 - 2 - Establish decon point
 - 3 - Mark contamination run-off
 - 4 - Check for completeness

° Employ chemical agent alarms in a static situation.

- Considerations:
- 1 - Detector units are upwind 200-400 meters (no more than 150 meters from perimeter/and not separated more than 300 meters apart)
 - 2 - Alarm units positioned properly to ensure immediate action
 - 3 - Operators perform services as required
 - 4 - Detectors are repositioned when the wind changes

° Employ chemical agent alarms in a mobile situation.

- Considerations:
- 1 - MOPP
 - 2 - Affix M9 detector paper to clothing and equipment
 - 3 - Check protective equipment
 - 4 - Establish casualty evacuation procedures
 - 5 - Check detection kits and alarms

° Respond to a persistent toxic chemical agent attack.

- Considerations:
- 1 - Take immediate action
 - 2 - Affix M9 detector paper to clothing and equipment
 - 3 - Check protective equipment
 - 4 - Establish casualty evacuation procedures
 - 5 - Check detection kits and alarms

° Respond to a persistent toxic chemical agent attack.

- Considerations:
- 1 - Take immediate action
 - 2 - MOPP 4
 - 3 - Warn Adjacent units
 - 4 - Submit NBC 1 (chemical) report
 - 5 - Determine type agent
 - 6 - Determine extent of contamination
 - 7 - Decon casualties
 - 8 - Shut down M8 alarms
 - 9 - Request decon support
 - 10 - Prepare downwind hazard
 - 11 - Initiate partial decon procedures

° Respond to a nonpersistent toxic chemical agent attack.

- Considerations:
- 1 - Take immediate action
 - 2 - Warn subordinate and adjacent units
 - 3 - Determine type agent/extent of attack
 - 4 - Submit NBC 1
 - 5 - Determine when all clear
 - 6 - Prepare downwind hazard

° Cross an area contaminated by a persistent chemical agent

- Considerations:
- 1 - Assume MOPP 4
 - 2 - Determine most expeditions route using an NBC 5 report
 - 3 - Alert higher headquarters for decon support
 - 4 - Vehicles are buttoned up or covered as much as possible
 - 5 - After crossing, determine extent of contamination
 - 6 - Establish decon priorities

° Perform unit sustainment decontamination of chemical agents (unsupported).

- Considerations:
- 1 - Use ABC-M11 on operator's controls
 - 2 - Emergency decon complete in 15 minutes after attack
 - 3 - Clothing Exchange accomplished as far forward as possible as required
 - 4 - Vehicle decontamination accomplished as required/ASAP
 - 5 - Determine adequacy of decon procedures
 - 6 - Request complete decon supply

° Coordination for complete decontamination of personnel and/or equipment.

Considerations: 1 - Establish unit's time of arrival
2 - Establish supplies unit required to bring
3 - Establish number of personnel required to support operation
4 - Determine route to PDS/EDS

The commander should also consider several appendices to this annex to ensure all required information is available so subordinate leaders can make informed decisions. Appendices should include:

° Examples of NBC 1-5 reports, effective downwind message, and chemical downwind message.

° Unmasking procedures.

° Radiation exposure chart.

° Comprehensive listing of chemical protective equipment (with national stock numbers) required to conduct sustained operations resupply.

° Procedures for simplified fallout prediction.

° Procedures for chemical downwind hazard prediction.

After the annexes have been written and staffed through the appropriate sections, they should be given to the commander for approval. Once the annexes are approved and become a part of the unit SOP, they must be implemented in two phases. First, you must conduct instruction to ensure that all members of the unit are familiar with the contents. The second phase of implementing is to provide supervision to ensure that personnel follow the SOP.

As changes are made to referenced publications, SOPs of higher headquarters, or unit procedures, you must update your SOP.

